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CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . . . L. W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

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A NEW PRINCIPLE FOR HEAT ENGINES.

A new method of burning fuel in a heat engine was suggested in a recent German periodical by M. Cantor. He proposes introducing the oxidizing medium in the form of a solid, such, for example, as a solid oxide of copper. This is to be maintained at an incandescent temperature, and against it is to be directed a spray of fuel. The fuel will be burned, the gas expanded, and used in the usual way; and the reduced oxide will be reoxidized by a jet of air. In this way the greatest possible ratio of expansion will be obtained, and the efficiency of the cycle will be increased. There are, of course, a number of objections to such an arrangement, but it, at least, serves the purpose of pointing out that there are other directions in which the heat engine might be developed, with possible improvement, than those in which we are accustomed to work. The steam engine owes its poor efficiency to the system employed, not to the machine; hence great improvement in it is impossible. The gas engine, while better off, is limited for the same reason, and hence it is most desirable that in seeking for better methods of generating power, we should look into all the possibilities, and not simply pin our attention to the mechanical features of the machine.

WHENCE THESE RICHES.

"How's business?" asked a visitor of an Oriental imperturbably awaiting his kismet of poverty or riches in a bazaar at the midway of a large exposition.

The reply of the man with the fez, "you buy. I tell business it good," contained an unconscious declaration of principles of political economy.

When people buy, business is good, and people are now buying and business is good throughout this country and Europe.

There is no tulip craze of chasing after idealities, but purchases are made to an extent which taxes the productive resources of manufacturing establishments, whose output is generally sold far in advance.

Labor strikes are unpleasant evidences of prosperity, which fail to put in appearance in times of stringency.

Extravagance, and not parsimony, is a prevalent characteristic of humanity; in general terms, every one is as lavish as he dares to be.

If miserliness were universal, it would defeat its own purpose by abating the earning power of money.

It is well that larger resources induce more abundant purchases the world over.

It is evident that the balance of the increment of the productive capacity of humanity is increasing, and this augmentation of the average potentiality of the individual is the only measure of this enlarged difference between production and consumption which constitutes the increase of prosperity.

It must not be overlooked that material possessions have not been destroyed in these territories by wars or extensive fires. Both of these annihilations of value have been the forerunners of financial crises; other losses are mere transfers of property.

It does not answer the proposition to attribute this fortunate commercial condition to machinery, for there have been no radical improvements in methods of manufacture or transportation of freights by land or sea during the last twenty-five years sufficient to introduce materially different economic conditions.

The term "labor-saving machinery" is largely a misnomer, for while the reduction of hours of labor in the face of the increased numbers of workers among growing populations has been compassed by the combined application of improved machinery and modern methods of organization, yet the function of machinery has served to increase production and to facilitate distribution to an extent which quickens the luxuries of one generation into the necessities of the next.

If there is now an increased surplus without any recent evidence of a corresponding addition to the rate of individual production, or any diminution of consumption of living ex-

penses, then it is among the wastes of recent years that search must be made for the cause of this increment.

The first analysis reveals the solution, and that is in the service of electricity applied to mankind, which has cut down wastes which were hitherto unavoidable.

The trolley railway service, particularly in suburban travel, enables people to live on cheaper land, in cheaper houses, or in comparison with the same sites of habitations has diminished the unproductive time in traveling to and from their work.

There are many people employed in New York whose traveling time has been reduced two hours a day, by methods of interurban transit, made possible only by electricity.

The use of the telephone is still the basis of wonderful anecdotes of how persons save days of travel about a city by a few local calls. Through the service of this instrument, or rather the system of which it is the nucleus, many of the vast army of messengers have been assigned to directly productive employments.

The vertical railway, as Otis Tufts properly entitled his invention of the passenger elevator, sufficed to make commercial buildings exceed three stories in height, but it is held that the modern skyscraper could not be used to house its thousands devoted to the intensities of commercial affairs within its score or more stories, had it not been for the facilities of communication afforded by the telephone service, because there is not sufficient room in such buildings for elevators adequate to transport the number of messengers which would otherwise be necessary for communication between these offices and their clients.

The condition of messengers in place of telephone service in a skyscraper presents a hypothetical aspect akin to that of the substitution of oarsmen for the propulsion of a steamship in which they would far exceed the capacity of the vessel, as it would require 720,000 men working in eight-hour relays to produce the 30,000 horse-power used on the large Atlantic liners.

It has been found in the course of studies by municipal engineers upon the sidewalk capacity of cities, that the facility of communication afforded by the telephone has diminished the relative number of persons walking in the business districts of cities during office hours.

The work of these specialists has been directed to providing means for abating the congestion at the beginning and end of working hours, and electricity is applied again to methods of rapid transit at these localities by introducing as many points of departure as possible within these congested districts.

For long-distance travel the telephone is a substitute which has added to productiveness in the measure to which the time that would otherwise be occupied in traveling may be devoted to profitable employment.

Of electric illumination in its especial application, wherever the difference between daylight and other methods of lighting impaired or even stopped accurate lines of work we are without apology always descanting, and shall continue to do so until these wonders shall cease to be of service to mankind.

A NEW ELECTRICAL DEVICE.

A newspaper clipping recently gives what purports to be a description of a new device for generating electricity, for which great claims are made. These claims may all be valid. We have no way of proving the contrary. In fact, we only wish that we could have more hope in the new device than this clipping inspires. It says that the company will manufacture engines which will make possible the production of unlimited electrical power from the three primary elements—heat, water and air. This sounds like a quotation from Chaucer put in modern English. Of course, any one is at liberty to call these three things "elements," if he wishes, but why should he do so at this day? In modern scientific phraseology none of these is considered an element.

Again, it is said that this device is an engine for the extraction from heat, water and air of unlimited electrical power, without the use of a boiler, engine or dynamo—a startling revelation of new methods of developing electricity. By the application of less than 400 degrees of heat to the apparatus, and by supplying it with air at twelve pounds pressure, and with water in required quantities to replace that which is evaporated, the device will go on for an indefinite period creating a current of electricity, which, measured by present devices, and tested by known methods, is found to be identical with that generated by the rotary dynamo.

By the way, this last emphasizes a lack at the present time; we have no means of testing the quality of electricity. All we can determine is whether it flows in one direction or the other, and whether it is steady.

The inventor of this new device says that it will convert forty-five per cent of the fuel's energy into electrical energy. This will surely be a distinct advance over present methods, which, even under the best conditions, are not half as good. We only wish that we could believe that further developments will bring more convincing evidence; and, to be convincing, evidence should at least be scientifically presented.

ELECTRIC HEATING.

Some few years ago electric heating was limited practically to electric cars, where safety and convenience outweigh other considerations. Electric cooking and heating appliances for the household were available, but found but small use. Every one was willing to admit the convenience and elegance of the new apparatus, but said that it cost too much to use them. At that time the full value of electrical heating appliances was not appreciated. To-day, if we can read the signs aright, the time is rapidly approaching when electric cooking and electric heating utensils will enjoy a deserved popularity. It is acknowledged that, comparing heat unit with heat unit, one delivered in the form of electrical energy, and the other in coal, the former seems to be far more expensive; but in almost every industry the cost of fuel is but a small part of the total operating expenses. This is true of cooking as well as any other operation. The old-fashioned coal stove, going all day long, is an extremely wasteful device, and is only tolerated because it has long been estab-

lished and because fuel is cheap. As against this inefficient method we have the nearly perfect efficiency of the electric heater. It is using power only when it needs it, and it delivers nearly all of this where it is wanted. Moreover, it is easy to control, and responds instantly. Simply as a device, the electric stove is almost ideal.

The public, it seems, is beginning to realize this, and the power companies, as well as the makers of electric apparatus, are doing what they can to educate it. In all of the recent electrical exhibits, the exhibits of electrical heating and cooking appliances have been large, and have attracted a good deal of attention; a good augury for future sales.

AN EFFECT OF GOVERNMENT OWNERSHIP.

A phase of government ownership which is ignored by those who at present are calling loudly for such steps to be taken is brought out in the following quotations from the report to the commonwealth of Australia by Mr. John Hesketh, electrical engineer in the postmaster-general's department at Queensland. Regarding the question of adopting an automatic system in Melbourne, Mr. Hesketh says that the agitation at present is governed by the comparatively inefficient system now in operation. "It is no reflection on the original designers of the Melbourne system to say that there is not at the present time any system seriously put before the telephone users for adoption in the large centres which would not be a distinct improvement upon the Melbourne system. I wish it to be quite clear that I do not intend the reference to Melbourne to be a reflection upon either the present control or upon the original designers of the system. It is to be remembered that the Melbourne switchboard is over twenty years old, and that at the time it was installed it was the latest pattern. In no part of the world, however, would such a pattern and system be now installed."

And it might be added that no private company could be operating successfully to-day with a telephone switchboard as much out of date as this one. Only recently we pointed out the wretched condition of the Paris system, due to the same cause. The Melbourne situation is probably only an exaggeration of the condition in the other large cities there. Indeed, some of them, so far as we know, may be even worse off. It is almost invariably a result of public ownership that the system is maintained long after it should be scrapped.

In contrast with this Melbourne condition are the instances of good telephone practice mentioned by Mr. Hesketh; and it is significant to note that the most improved system which he advises the government to adopt is the one which has been so thoroughly developed in this country, and is now generally in use here; and, so far as we know, there is not a single public telephone system owned by a government in the United States.

A few years ago it used to be the custom to ignore charges for interest and depreciation in reporting on municipal plants. In this regard custom has somewhat improved, but there is the equally important item of renewals, which is generally overlooked. Yet no private company could maintain its success if it forgot to allow for scrapping the old plant and installing new whenever a decided advance has been made in the art.

REFUSE DESTRUCTORS.

Not infrequently the value of refuse as fuel is urged in connection with the establishing of city garbage destructors. Some even have gone so far as to compute that the refuse of a city has sufficient calorific value to supply the lights for all the municipal works. This figure seems to be reached by burning a given quantity of refuse, measuring the heat given off, and then assuming that this can be used as effectively as if it were produced by coal under an ordinary boiler. This is not necessarily so. While the refuse has undoubtedly a certain calorific value as a fuel, this can not be taken as being strictly proportional to the amount of heat which it liberates. There are other items to be considered: the temperature of the fire, for example. Generally speaking, the hotter the furnace, the more efficient the boiler; but with a green fuel like refuse, a high temperature can not be expected. Indeed, at times the addition of coal or a previous drying may be necessary before the fuel can be burned at all.

All of these factors militate against the use of refuse as a fuel in a plant where the best conditions call for a certain uniformity of material and regularity of operation. Anything that adds to the complexity of a modern power plant is undesirable, and while it is, of course, desirable not to waste any heat, yet, everything considered, it would probably be better to keep the two plants separate, except possibly in some minor plants. Undoubtedly, the best way to get rid of city refuse is to burn it, and the heat thus obtained should be used, if it does not cost too much to do it; but, in the long run, it would seem better not to have the operation of an important electric light and power station depend in any way upon such an unsatisfactory fuel. If the power plant is so large that the heat delivered to it by the destructor is inconsiderable, and in no way affects its operation, then the objection might not be so serious, but wherever there is a large power plant there is apt to be a large amount of refuse to be disposed of, and while the operation of the two in conjunction is advantageous from the destructor's end, it is undesirable from that of the power station.

Some figures showing the value of city refuse were mentioned recently by Mr. J. M. M. Munro, in an address at Glasgow. Figures from the Hackney (London) destructor show that the evaporation of water per pound of refuse is 1.4 pounds, which, compared with the cost of power of the Glasgow Railway Company, brings the value of this fuel to about twenty-five cents per ton; yet, Mr. Munro says, it would not pay the generating station to buy the refuse at that price for fuel, as the total costs of burning it, including interest, depreciation, taxes and labor, etc., vary from ninety cents to $1.60 per ton destroyed. Figures for the Partick plant are even less favorable, for there only eighty-eight kilowatt-hours are generated per ton of refuse, making the value of the fuel about twenty-one cents per ton. It is not stated how much it costs to burn this fuel. These figures show that the heat given off at such a plant is worth utilizing, but it should be applied to cruder purposes than in generating electrical energy. It might be used for heating public baths, except that it is not desirable to have the destructor anywhere near the bath. But there are other ways in which it might be employed without so much objection.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

BY HARRY C. JONES.

CHAPTER XIII.

Radiations Given Out by the Emanation.

We have seen that the emanation is material, and has many of the properties of an ordinary gas. We have also seen that when the emanation is present in the radium, the latter gives out α, β and γ radiations. The question arises whether the emanation gives out all three types of rays, or only certain special types, or does it give out any radiation at all?

This was tested by Rutherford in the following way. The thorium containing emanation, was placed in a box of lead, having a hole in the top that was covered with a plate of mica. The radiation from the emanation that passed through the mica was tested by its power to ionize the gas above it. When a thin metal disc was interposed in the path of the radiation, most of the radiation was cut off. This showed that at least most of the radiation consisted of α rays. No evidence was obtained that any β rays were present.

In the case of the emanation from radium, the test as to its nature was made as follows: The emanation was introduced into a copper tube, whose walls were thick enough to cut off all the α rays. No β or γ rays were given out by the emanation itself.

The emanation gives out then only one type of radiation, and that is the α type. No β or γ rays come from the emanation either from thorium or radium. It will be remembered that the α rays are composed of positively charged particles, having a mass about twice that of the hydrogen atom, and moving with a velocity which is about one-tenth that of light. It will also be recalled that it is the α particles that have most of the energy given off by radioactive substances, since they have appreciable mass and very high velocity. The α rays are the chief agents that ionize a gas subjected to radioactive substances, and are the most important radiations given off by such substances.

Having found that the emanation gives off α particles, the next question is, do *all* the α particles shot off from radium come from the emanation contained in it, or has de-emanated radium any power to produce α rays? This can easily be answered. When all of the emanation is removed from the radium salt by heating, the remaining de-emanated radium also has some power to give out α particles.

Measurement of the Relative Emanating Power of Different Substances.

We cannot measure the absolute amount of the emanation given off in the same time by different substances. The best we can do is to measure the relative amounts of the emanation in different substances, or produced by different substances in the same unit of time.

The method that was employed by Rutherford and Soddy for salts of thorium, is the following:

The thorium compound in weighed quantity was placed in a glass tube, through which air filtered free from dust and dried over sulphuric acid was passed. The mixture of air and the emanation, filtered through cotton wool to remove ions, was passed into a brass tube about three-quarters of a metre long and six centimetres in diameter. Three insulated electrodes were inserted at regular intervals into the brass tube, and these were connected with an electrometer. The metal tube was connected with one pole of a battery, and the other pole connected to earth. The emanation carried into the tube by the air, was measured by its ionizing effect on the air in the tube, as shown by the current that passed between the walls of the tube and the electrodes. This current, as measured by the different electrodes, acquired a constant value after the mixture of air and emanation had been passed into the tube for a short time.

After a constant current had been obtained, an equal weight of a substance with whose emanating power that of the first substance was to be compared, was introduced into the tube in the place of the substance under investigation, and the constant current for this standard substance determined and measured. The emanating powers of the two substances bore the same relation to one another as the values of the two currents.

It is obvious from a study of the above method, that these measurements of the relative emanating power of different substances are really measurements of the relative rates at which different substances give off the emanation. This has been shown to be affected by a number of conditions. Thus, Rutherford has shown that the emanating power of thorium oxide and radium chloride is much greater in the presence of a moist gas than when dry. He has also shown that the emanating power of thorium oxide is increased several times when the compound is heated to dull-redness. When the compound is cooled again to ordinary temperatures, it gives off the emanation at the same rate that it did before heating. If, however, the compound was heated to a white heat, and then cooled; it was "de-emanated" or gave off only a small amount of emanation. The same result was obtained with compounds of radium. When these substances are heated to a white heat and then cooled, the rate at which they produce the emanation is apparently permanently much less than before they were de-emanated.

Rutherford also studied the effect of *low temperature* on the rate at which the emanation was produced. He found that the emanating power of thoria was diminished to about one-tenth at the temperature of solid carbon dioxide.

M. Curie found that the emanating power of radium compounds was much increased by dissolving them in water. The meaning of some of these empirical facts will appear when we come to study the nature of the changes that are taking place in radioactive substances.

Recovery of Emanating Power.

It was stated above that when thorium or radium compounds are subjected to a high temperature they become de-emanated, or lose most of their emanating power. It was also stated that this change is apparently permanent. We shall now see that it is only apparent. If highly heated, and therefore de-emanated thorium oxide is dissolved, the hydroxide precipitated, and the thorium oxide obtained again by heating the hydroxide, this thorium oxide gives off the emanation at the rate that is normal under the conditions.

This shows that the de-emanation by heat is not a permanent change, the heating simply increasing the rate at which the emanation escapes.

Decay of the Emanation.

If we study the emanation by means of the apparatus used for measuring relative emanating power, which was just described, we would find that the activity of the emanation rapidly diminished. The activity of the emanation obtained from thorium *decreases to one-half its initial value in about one minute,* and almost entirely vanishes in a very few minutes.

The activity of the radium emanation is, however, more persistent. The most careful work on this problem is undoubtedly that of Rutherford and Soddy. A mixture of the emanation with air was preserved over mercury, and samples removed and examined from time to time. They found that the activity of the em-

anation from radium fell to half the initial value in 3.7 days.

The *rate of the decay of the emanation seems to be independent of the conditions* to which the emanation is subjected. Even *high temperatures have no affect on the rate,* and when the emanation is condensed to a liquid at low temperatures, the decay goes on at the same rate.

HEAT EVOLVED BY THE EMANATION.

We have discussed at some length in an earlier chapter the remarkable heat-producing power of radium. We have seen that the amount of heat energy liberated by radium is one of the most surprising facts in physical science. We have also learned that the heat-emitting power of radium increases like the activity in newly prepared salts for a month, and that the production of heat was, therefore, vitally connected with the radioactivity.

We have now studied in some detail the unique substance which is being constantly produced and given off by radioactive substances, known as the emanation. We have seen that, considering its quantity, it is extremely radioactive. Indeed, much of the radioactivity of radium and thorium can be referred to the emanation produced by and contained in them.

We would naturally ask does the emanation have anything to do with the enormous production of heat energy that is taking place in radium salts, and if so, what?

The answer to this question we owe to Rutherford and Barnes. They worked with thirty milligrammes of the bromide of radium and determined the total heat emission of this substance.

They then distilled off the emanation and condensed it in a tube surrounded by liquid air. This tube was sealed up while immersed in the refrigerating agent. The heat that was liberated by the emanation in the tube was then measured from time to time, and also the heat that was liberated by the radium bromide from which the emanation had been distilled. The sum of the heat liberated by the emanation plus that liberated by the bromide from which the emanation had been obtained, was always equal to the total amount of heat set free from the original bromide.

When the emanation was giving out a maximum amount of heat energy, the surprising fact was established that *from seventy to seventy-five per cent of the total heat given out by radium salts comes from the emanation contained in them.*

This fact is even more wonderful than the discovery that small amounts of radium salts can give off such large amounts of heat energy. We have now traced the source of most of this heat energy to the almost infinitesimal quantity of emanation contained in such small amounts of the salts of radium that are at present at our disposal.

We have learned much earlier that the α particles, having comparatively large masses and very high velocities, produce heat when they strike upon solid objects and are brought to rest. The production of heat would thus be nearly proportional to the number of α particles given off. We have also learned that the emanation sends off only α particles, and produces nearly three-fourths of the heat that is given off from radium salts. We can, therefore, conclude that nearly three-fourths of the α particles given off by salts of radium come from the emanation contained in them.

HELIUM PRODUCED FROM THE EMANATION.

We have already encountered a number of remarkable and surprising facts in connection with the radioactive elements and the emanation produced by them. Perhaps the most remarkable still remains to be considered. We have seen that the activity of the emanation gradually decays and finally becomes zero. This necessitates the conclusion that some fundamental change is going on in the emanation itself.

A number of questions arise in this connection. Especially prominent is this one. If the emanation is undergoing decomposition, into what does it decompose? What is left in a tube containing the emanation after the emanation has ceased to be radioactive?

If we go back to pitchblende—the source of most of our radium—we find such a large number of things, that it would appear difficult to say that any one of them was a product of the decomposition of the emanation from the radium contained in this mineral. We, however, find most of these substances occurring with other associations somewhere in nature where no radium is present, and they, therefore, could not be the final product of the decomposition of the radium emanation.

If we examine the radioactive minerals closely we will see, however, that they contain one substance, of which the above remark is, at best, only partially true. This is the element helium.

This element, as has already been pointed out, was first discovered spectroscopically in the sun by Lockyer. It was first discovered among the terrestrial elements by Ramsay. This discovery has an interesting history. Ramsay was working with Lord Rayleigh on argon, and had studied its properties, and especially its chemical inertness. In this connection it occurred to him to examine the inert gas previously obtained from the mineral Clévite, to see whether it was not argon. He examined it spectroscopically and found a prominent yellow line near the sodium line, which he could not identify as coincident with that of any known terrestrial element. However, on comparing it with the line discovered by Lockyer in the sun, Ramsay found that the two were identical.

Helium was thus shown to exist among the terrestrial elements.

It should further be pointed out that helium, as far as it occurs at all in minerals, is only to be found in the radioactive minerals. Helium is also found in the waters of certain springs, but probably comes from radioactive minerals which are at some depth below the surface of the earth.

Taking these facts into account, and also the properties of the emanation from thorium and radium, Rutherford suggested that the emanation on decomposing might yield some inert element of the type of those in the argon family.

On account of his ability and experience in working with small quantities of gases, Sir William Ramsay undertook the study of the nature of the emanation, in conjunction with Prof. Rutherford's assistant, Mr. Soddy.

They dissolved 30 milligrammes of radium bromide in water, and collected the emanation in a sparking tube. The sparking tube was connected with a U-tube which was surrounded by liquid air. This condensed any carbon dioxide that was present in the emanation as an impurity, and also the emanation. If any helium was produced from the emanation, this would not be condensed by the liquid air, since helium is the one gas that has not been liquefied by any means, even up to the present time.

When the spectrum of this tube was taken, a bright yellow line made its appearance, which was not far removed from the sodium line; but even with a small spectroscope could be seen *not to be identical with it.* A careful measurement of *this line showed it to be identical with the D_3 line of helium.* This preliminary experiment with its remarkable result, led to further very careful work on the problem. The emanation from 50 milligrammes of radium bromide was collected in a U-tube by driving it over with oxygen, and then condensed in the tube by means of liquid air. It was then trans-

ferred to a Plücker sparking tube, and the spectrum taken. *At first there were no helium lines present,* but a new spectrum, presumably that of the emanation itself, made its appearance. *In a few days the original spectrum disappeared and the spectrum of helium came out sharply.*

Thus was observed for the first time in the history of science the formation or production of a chemical element. Whether it comes directly from another definite chemical element is not certain. It has not been shown, although it is highly probable, that the emanation is an inert chemical element. It is, however, certain that helium is thus spontaneously produced from a chemical element—radium—as one of its decomposition products.

(To be continued.)

The Annual Meeting of the Electrical Committee of the National Board of Fire Underwriters.

The annual meeting of the electrical committee representing the National Board of Fire Underwriters on the rules for the safe wiring of electrical plants, held its annual meeting at the hall of the board, 32 Nassau street, New York city, on December 6 and 7.

Mr. F. Eliot Cabot presided, and Mr. C. U. Goddard acted as secretary of the meeting, and it was to the courtesy and skill of these officers that the large amount of detail was despatched with great rapidity, without, however, closing any discussion which promised to contribute to the subject.

In addition to the electrical experts of the Board of Fire Underwriters, many of the electric inspectors from all parts of the country, except the Pacific coast, were present.

In addition, many representatives of the leading electrical enterprises, and also a number of professors of physics or of electrical engineering from various colleges or scientific institutions were in attendance.

The gathering was so thoroughly representative in its inclusion of every element of the practically constructive and the ethically theoretical principles of the applications of electricity, with the possible exception of submarine telegraphy, that it did not appear that any question on the subject could arise, without finding among those present persons who could contribute their experiences or opinions.

The questions to be considered at this meeting had been printed in a bulletin, which contained reports of committees and 122 amendments to the National Electrical Code, in addition to twenty-nine miscellaneous suggestions, which appeared to be, for the most part, in the nature of amendments not drawn to precise form.

These amendments had been sent to the secretary from all sources, most of them, it was understood, from insurance electrical inspectors in the field.

The electrical committee had considered these suggestions, and when they were presented, the secretary gave the information as to whether they had received the approval of the committee, and this proved to be of great assistance in the facilitation of business.

The consensus of opinion of the meeting evidently agreed with the sentiment frequently expressed by those engaged in the manufacture or installation of electrical apparatus, that the National Electrical Code, with its 132 pages, was sufficiently voluminous, and that its requirements should not be changed, except for abundant cause, for out of the 122 amendments proposed to the rules, only twenty-five were approved by the vote of the meeting, and about the same number received favorable action after being amended.

The greater part of these rules were in the nature of different methods of expression to avoid misunderstanding, and it does not appear that any of these changes introduced radically new methods into the code, but were in the nature of making present requirements clearer.

Favorable action was taken on three resolutions which were adopted by the national conference on standard electrical rules at its meeting December 4, copies of which had been transmitted to the underwriters' meeting, and announced in the last issue of the ELECTRICAL REVIEW.

One resolution commended the grounding of low-tension secondaries of alternating-current systems wherever reliable connections could be secured.

Another resolution stated that in case of three-wire systems with grounded neutral, the ground wire should be a solid connection without fuses.

The third resolution approved of the grounding of secondary alternating-current systems to water pipes, and declared that such connections were not merely safe, but placed no additional burden or menace on such water pipes.

These resolutions will serve a most useful purpose, not to the electrical engineer or to the insurance specialist who is an expert on the electrical fire hazard, but to the great number of laymen in positions of executive authority in cities and towns, by whom it may not be understood that the function of such ground wires is intermittent, and even when in use these alternating currents can not be considered as having any relation to the problems of electrolysis or damage by lightning.

Outside of the results of the council of various electrical interests together, it appears that these meetings serve a useful purpose which could not be reached by the underwriters or by any one class of men acting alone.

American Society of Mechanical Engineers.

The fifty-second meeting of the American Society of Mechanical Engineers was held in New York city from December 5 to 8, inclusive. A programme of the meetings was published in the ELECTRICAL REVIEW for November 18. All of the papers, with one exception, were upon subjects not particularly interesting to electrical engineers. The exception was that of Mr. H. F. J. Porter, which was published in the ELECTRICAL REVIEW for December 9.

The professional sessions of the society were held on Tuesday evening and Thursday and Friday mornings, at the Edison auditorium, 44 West Twenty-seventh street. The Wednesday morning session was held on the steamship Amerika, of the Hamburg-American Line, at the company's dock at Hoboken, N. J. This was the business meeting of the society, at which the report of officers was submitted and officers for the ensuing year elected. The following are the new officers:

President, Fred. W. Taylor, Philadelphia, Pa.

Vice-presidents, Walter M. McFarland, Pittsburg, Pa.; Edward N. Trump, Syracuse, N. Y., and Robert C. McKinney, New York city.

Managers, Walter Laidlaw, Cincinnati, Ohio; Frank G. Tallman, Cleveland, Ohio, and Frederick M. Prescott, Milwaukee, Wis.

Mr. W. H. Wiley, New York city, was reelected treasurer, and Mr. Frederick R. Hutton, also of New York, secretary.

During this meeting an address of welcome to the Amerika was delivered by Mr. Emil Boas, general manager of the Hamburg-American Line. Mr. Boas outlined briefly the remarkable development of his company, and stated that at the present time the total tonnage is more than that of such countries as Russia, Sweden and Holland. The steamship company also distributed to the members in attendance souvenirs, consisting of an illustrated description of the Amerika and a framed lithograph of the steamship.

A reception and conversazione was held at Sherry's on Thursday evening.

Hydraulic Station on the Sioule River for Supplying the Town of Clermont-Ferrand, France.

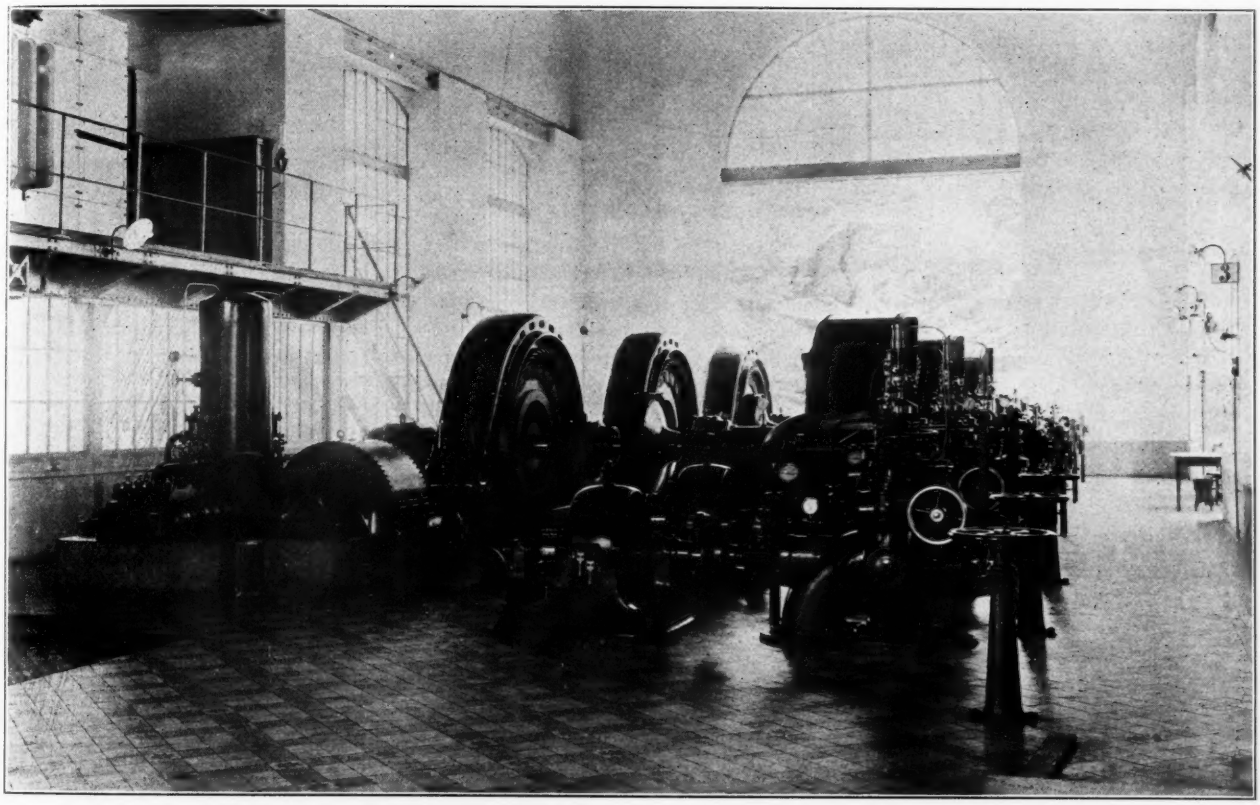
By C. L. Durand.

AMONG the most recent hydroelectric plants which have been erected in France is the turbine station which is now in very successful operation on the Sioule river. The electric plant is used for supplying light and power over a long-distance line to the towns of Clermont-Ferrand and Royat. The former town is the most important locality in the Auvergne region, and lies some distance to the west of Lyons.

The gas company of Clermont-Ferrand had been running an electric station for some years past which contained steam engines and dynamos for the current supply needed in these two localities, and operated it on the 2,000-volt, forty-two-cycle system. But during the last few years the demand for current kept increasing, and the plant, which was only of moderate capacity, soon proved insufficient. The extensive use of motors in the various industries was one of the reasons for the large amount of current which was required. At first it was proposed to simply increase the output of the old station by adding a certain number of groups, but the gas company afterward decided to use a system of power transmission and a hydraulic plant, seeing that the mountainous character of the region was favorable for securing the required amount of hydraulic power and this also allowed a good margin for a further increase in the plant which was likely to be needed in the future. Besides the towns of Clermont-Ferrand and Royat, the new plant was designed to supply current throughout all the neighboring region.

The Sioule river was chosen as best adapted for supplying the power for the hydraulic station, and the plant was installed upon this stream in the neighborhood of Queuille at a distance of twenty miles in a straight line from Clermont. The Sioule, which is an affluent of the Allier, rises on the west slope of the Monts-Domes and the water supply is secured from this stream under favorable conditions, on account of the altitude of the mountains and the climatic conditions, seeing that the snow melts only at a late period in this region, and this affords a longer season of high water. The river is also subject to freshets, which are frequent, as is the case generally with mountain streams. During the building of the plant the amount of water which was delivered at the time of the freshets was observed to exceed 147,500 cubic feet per minute. However, in seasons of low water the supply usually falls as low as 15,800 cubic feet per minute.

At the point where the turbine station is situated, the river runs through a deep and winding valley, and this circumstance, added to the conditions of variable output of the stream, led to the construction of a dam from which the penstocks brought the supply directly to the station, which is placed at the foot of the dam, this being found preferable to the use of an offtake canal. The dam is built for an eighty-two-foot head of water during the high-water periods. The penstocks of the turbines, as the accompanying section shows, are built directly into the masonry of the dam at a height of fifty-six feet, and a penstock is provided independently for each turbine. On each end of the dam next the shore have been constructed two overflow



DYNAMO ROOM, SIOULE RIVER HYDROELECTRIC POWER TRANSMISSION TO CLERMONT-FERRAND, FRANCE.

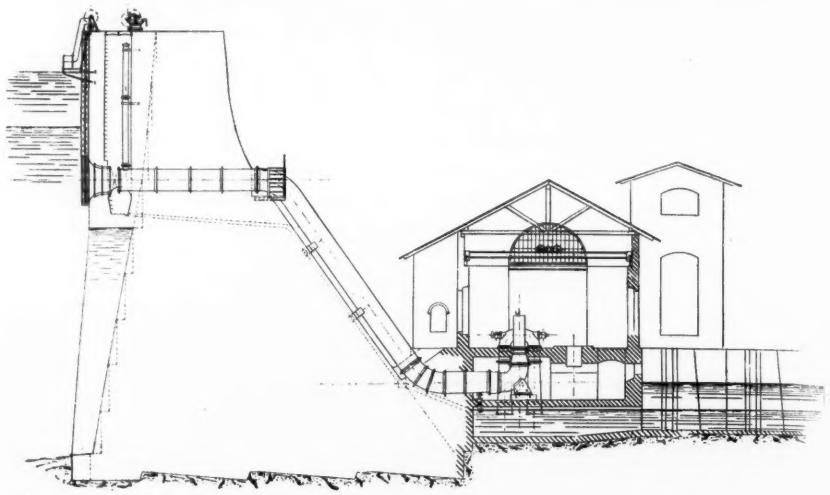
canals for taking off the surplus water. The dam, which has some 40,000 cubic metres of masonry, is built thirty-two metres high and has a base ninety-two feet wide and ninety-seven feet long, while the upper part of the dam has a total length of 393 feet. To give it greater strength, it is built in the form of a curve having 985 feet radius. The dam thus forms a lake which is about five miles in length and has a mean width of 492 feet. The quantity of water which is thus stored up seems to supply the station during the periods of low water. The company has also a project for securing an extra water supply by forming another reservoir above the former which will contain 350,500,000 cubic feet. This is to be constructed as soon as the demands for current require it.

The electrical outfit of the station, as well as the turbines, has been constructed by the Société Anonyme Westinghouse, which is the French branch of that company. The station building lies directly below the dam, as will be observed in one of the engravings and also in the sectional view, while another section shows the arrangement of the interior. Besides the main hall, which contains the principal turbine and dynamo groups, there is an annex of three stories. On the lower floor, and on the same level as the main hall, is a room which contains the sets of raising transformers for the high-tension lines. Above this, and upon a gallery which overlooks the dynamo room, is a main switchboard for the machines, and behind it in a separate room is a switchboard for the high-tension circuits built in armed cement. In the upper story are installed the lightning arresters and the terminals of the high-tension feeders. The above arrangement reduces the length of cable lying within the station, which is an important point.

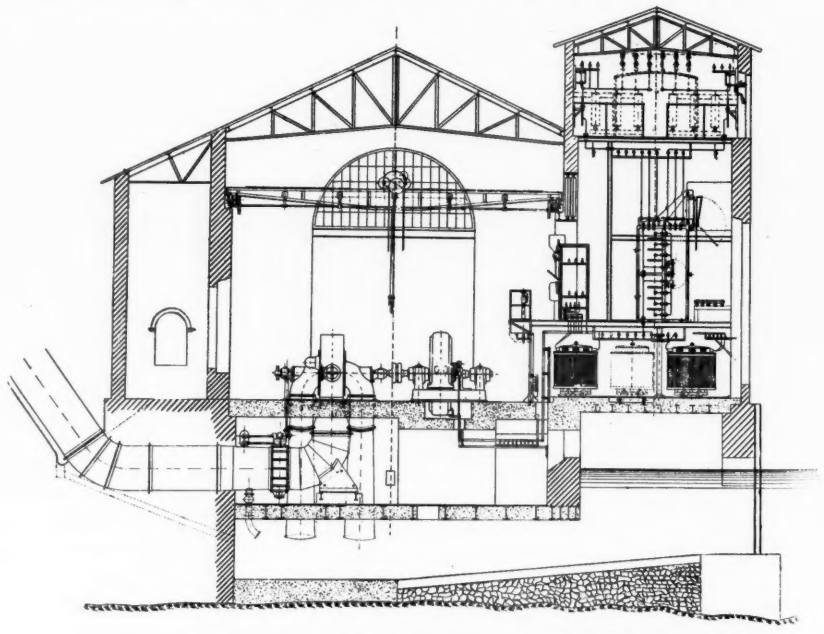
The main dynamo hall has been designed to contain six turbine and dynamo groups of 1,200 horse-power each. One of the groups is used as a reserve. At present there are three main groups and two exciter sets with separate turbines already mounted and running. The turbines of the Sioule plant are of the Francis type, and are double wheels with horizontal shaft. They have been built at the Havre works of the Westinghouse company under the direction of Escher Wyss & Company, the well-known turbine constructors of Zurich. The water feed is carried out by means of a set of pivoted vanes, which are mounted so that their position is regulated by a lever and rod device. The latter is operated from a separate motor, which consists of a piston working within a double cylinder by means of oil under pressure. A spring governor, which is operated directly by belt from the turbine shaft, acts upon a valve and allows the oil supply to act upon one or the other side of the piston so as to give the movement of the turbine vanes. The oil supply is taken from an air-pressure tank which is kept at a pressure of eight or ten atmospheres and is fed by a special pump. The latter, which is operated by a small turbine, draws the oil from a large tank placed in the basement of the building, and the oil returns again to the same tank after it has passed through the oil motor.

The turbines are built to work on a head of water which varies from sixty-nine feet to eighty-two feet, and operate at 333 revolutions per minute. The regulating system keeps the speed very close to the normal, and with a variation from full load to no load, the change in speed is only two per cent at the maximum in case the load is thrown off gradually, and where it is suddenly thrown off, a twenty-five per cent change of load gives a three per cent change in the speed, while for 50 and 100 per cent change we have five and seven per cent respectively. The water is led to each turbine by a separate penstock having 1.6 metres inside diameter.

The three-phase alternators, which have been also constructed at the Havre works, are coupled direct to the turbine shaft by means of Zodel elastic insulating couplings. The alternators have a capacity of 1,000 kilowatts each and deliver current at 1,000 volts, running at the normal speed of 333 revolutions. These



SECTION OF DAM AND POWER-HOUSE, CLERMONT-FERRAND POWER TRANSMISSION.



SECTION OF POWER-HOUSE, CLERMONT-FERRAND POWER TRANSMISSION.

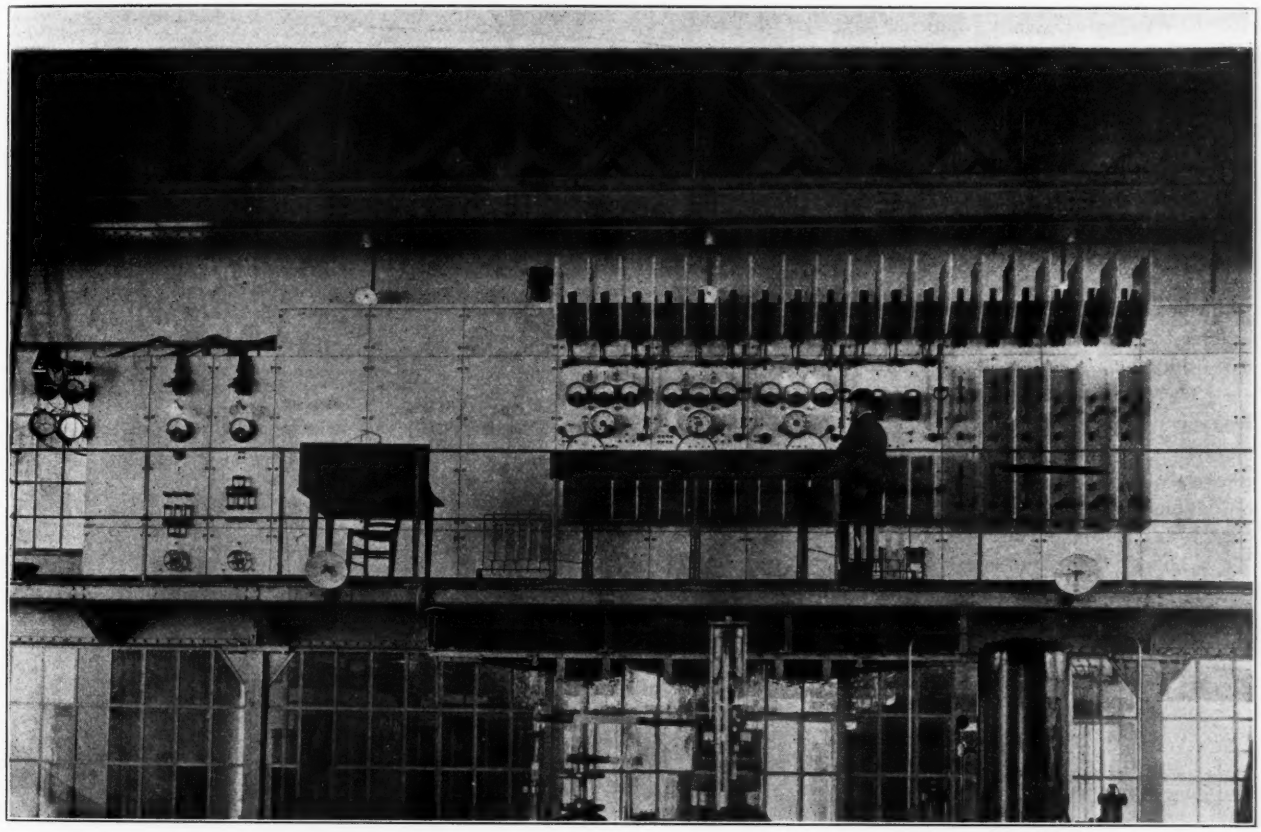
machines have eighteen poles and operate at fifty cycles. They are of the induction type with revolving field and fixed armature. The outer casting, which contains the armature, is mounted on a common base-plate with the two bearings and can be shifted to one side so as to clear the field. The armature winding consists of copper bars well insulated with mica and run into slots which are partially closed. The pole-pieces of the revolving field are formed of annealed iron and are dovetailed on to the cast-iron drum. Flat copper winding is used in the field coils. The fields of the machines are provided with the Leblanc coil apparatus which gives a great steadiness when they are run in parallel.

One of the engravings shows a view of the main switchboard which occupies the gallery overlooking the dynamo room. On the iron frame are mounted thirteen white marble panels, of which three panels are used for the exciters, six for the alternators and four for the transformers. At the front of the switchboard and at the top are placed the circuit-breakers and carbon switches which are constructed so that the copper brushes are the first to carry the current, and then as the resistance at the brushes continues to increase the current is gradually shunted into the carbons and is finally broken upon the latter. Hot-wire instruments are used to a great extent for the measuring instruments of the switchboard. Besides the ammeters and voltmeters, the board also contains a set of indicating wattmeters of the Westinghouse type. Each alternator is provided with a wattmeter which measures the total momentary load per machine, taking account of the power-factor of the lines. Westinghouse synchronizers have been provided for throwing the machines in parallel, and this apparatus has the same general form as the measuring instruments.

The switchboard has been designed so that the connections of the apparatus will allow of having two separate sets of busbars running throughout. This allows a certain number of units to be run separately, either to supply the power circuits or for lighting. Besides, this arrangement makes it easier to operate the distribution switchboard and to take care of the apparatus.

The room which has been laid out for the step-up transformers of the line is arranged to contain eventually four groups of three monophase transformers each, which are capable of transforming the whole power of the station. At present there are two principal groups and two reserve groups installed. Each transformer of the monophase type has a capacity of 375 kilowatts and the ratio of voltage is 1,000 to 20,000 volts at fifty cycles. These transformers, as well as the machines of the station, can support a considerable overload, and when running at full load showed on the tests an efficiency of 97.7 per cent, and 97.1 per cent at quarter load.

The primary and secondary windings of the transformers are formed of flat coils, which are disposed fanwise about a core of thin laminated iron, and the whole is contained in a corrugated iron tank filled with oil. No other cooling apparatus is used for the transformers, either in the prinicpal station or the substations, and this is found to be an advantage over the motor-fan cooling system which is so fre-



MAIN SWITCHBOARD, SIOULE RIVER HYDROELECTRIC POWER TRANSMISSION TO CLERMONT-FERRAND, FRANCE.

Besides the principal groups, the station is also to contain three exciter groups, each of which has a separate turbine. At present two of the exciter groups have been installed, and besides the exciting current, they supply current for heating and for a part of the lighting of the station. The turbines which operate the exciters are of the same type as the main turbines, and they have a capacity of eighty horse-power, running at 900 revolutions per minute. The exciters are of the standard Westinghouse compound pattern and are of the four-pole type, giving fifty kilowatts at 125 volts.

quently used, seeing that it dispenses with all inspection of the apparatus. The monophase transformers are connected on the triangle system by means of knife-edge switches both on the high and the low-tension sides. In this way the use of monophase transformers gives an advantage, seeing that any one of the transformers can be easily thrown out of circuit without needing to work with soldered or screw connections. Besides, each transformer is mounted permanently upon a carriage which allows it to be easily shifted in case of accident. Owing to the isolated position of the station and the difficulty of transporting the heavy pieces of apparatus to the railroad for sending them to the factory, it was decided to construct a small repair shop within the station, which is especially devoted to winding and insulation. In this way all the needed repairs of machines or transformers, etc., can be easily carried out, and it seldom happens that any of the pieces need to be returned to the factory.

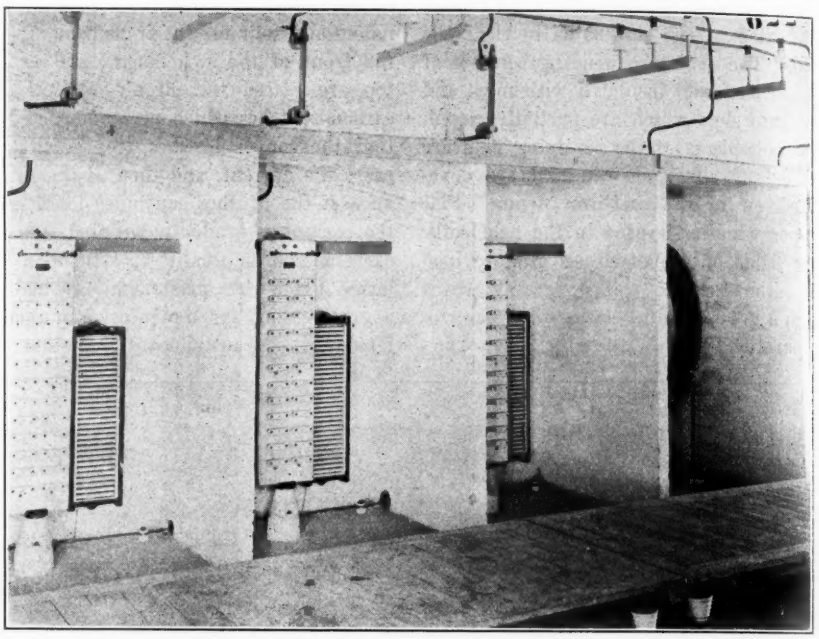
From the step-up transformers, the high-tension circuits at 20,000 volts pass into a special board which is laid out to receive the apparatus and bus-bars. It is formed of a framework of armed cement in which the 20,000-volt wires are separated from each other by cement partitions. The high-tension switches are each placed in a fireproof chamber as well as the switches. In the circuits of the transformers are placed the fuse-blocks, which are contained in a set of cement chambers in the upper part of the switchboard.

The 20,000-volt switches which are used in the Sioule plant are of the oil pattern and have the forms of circuit-breakers, which work automatically, but they can be also worked by hand. The automatic break system is arranged to come into operation in case there should be an overload on any one of the phases of the distribution system. The release of the circuit-breakers is carried out by relays which are operated from a low-voltage current. The latter is supplied by special transformers, which are placed in the 20,000-volt circuit.

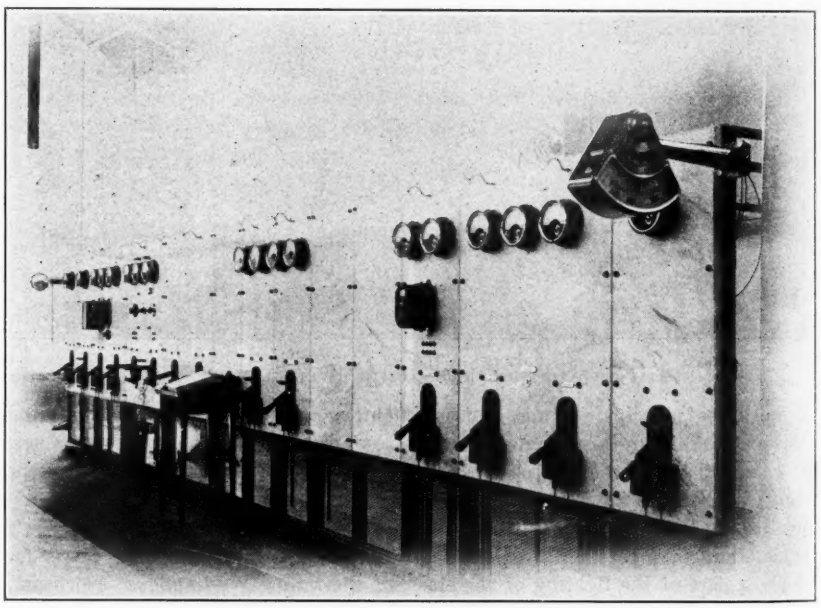
From the circuit-breakers the lines mount up to the chamber in the upper story, which contains the lightning arresters, and here they are connected to the main distribution system, which consists of two separate triphase lines at 20,000 volts, which run in the direction of Clermont-Ferrand. In the principal circuit a set of specially designed choke-coils is placed in series. These coils are needed in order to give a strong reactance on the static discharges coming from the overhead lines, and to turn them into the lightning arresters and thus protect the apparatus of the station.

The reactance coils are formed of a great number of turns of copper strips which are wound so as to form a flat coil having a rather large diameter, and the turns are well insulated with mica. These coils have been designed so as to assure the greatest amount of protection for the plant without forming any appreciable inductive resistance for the ordinary current, and also without using too much copper. The heat is quickly carried off by radiation from the large surface. As these coils are obliged to stand the whole force of the lightning discharges, the insulation has to be specially strong.

After the choke-coils are placed the lightning arresters, according to their arrangement, which is shown in one of the engravings. The lightning arresters are of the Wurts non-arcing type and therefore will not need to be further noted, except to show the arrangement which has been adopted in the Sioule station. At the moment preceding the atmospheric discharge, the potential rises and the current clears the adjustable air-gap and the spaces in series between the non-arcing



LIGHTNING ARRESTER COMPARTMENTS, MAIN STATION, CLERMONT-FERRAND TRANSMISSION SYSTEM.

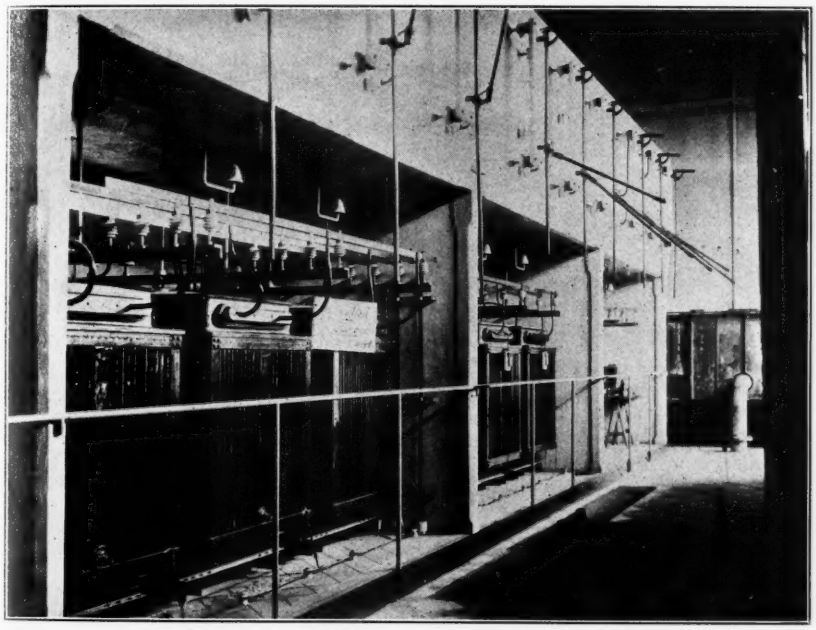


3,000-VOLT SWITCHBOARD, CLERMONT SUBSTATION, CLERMONT-FERRAND TRANSMISSION SYSTEM.

metal cylinders. The discharge which has been able to clear these spaces then clears the next series of gaps, but as these are shunted by the resistance, part of the discharge passes by this resistance and this cuts down the passing current, giving a better extinction of the arc. The discharge continues to pass by the spaces and the two resistances and the two latter thus cut down the discharge so that the arc will not hold up in the series gaps.

Owing to the good working of the lightning arresters on the above plan, it was not found necessary to mount any pole arresters along the overhead line, and this proved to be a good advantage, seeing that the pole arresters are always a source of trouble.

The overhead system includes a main line connecting the hydraulic plant with the principal substation at Clermont-Ferrand, a branch line at high voltage which runs from the Volvic cabin to Mozac, another branch from Clermont-Ferrand to Pont-du-Chateau, besides a series of low-voltage lines at 3,000 volts. The length of the main line to Clermont-Ferrand is about nineteen miles and it has six wires of 0.4 inch each, forming two separate three-phase systems which can be run singly or in parallel.

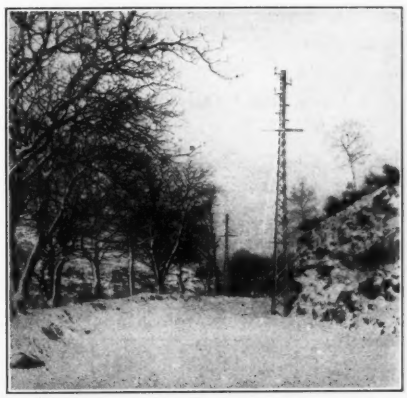


TRANSFORMERS, CLERMONT SUBSTATION, CLERMONT-FERRAND TRANSMISSION SYSTEM.

The construction of the overhead line, which is sometimes neglected, is carried out in this case with the greatest care, and it differs in many points from the lines which have been previously built. The construction has been carried out according to the designs proposed by the Westinghouse company. The principal points which we may mention lie in the use of a new form of metallic post or pylon, which has a small base, also in the long spans of the line and in the special type of insulators which are used.

The use of the metallic pylons allowed of shortening up the line considerably, as the line which was planned for wood poles gave a length of twenty-four miles. Besides giving a stronger construction, the pylons can be spaced far apart, cutting down the expense for insulators and of ground purchase where the wires run in a straight line across private property. The energy loss is also smaller for the shorter line. Owing to the fact that the property in this region is divided into small parcels, the space occupied by the poles becomes important, and to avoid the double pole with cross-arm which is frequently used, a new type of pylon was designed, which has a small base, but is of heavy build. This construction will be noticed in one of the engravings. It is designed to carry a double line, such as is used in modern practice. On either side the wires are placed at a different level, so that they will not swing together. The span is calculated at 100 metres, which gives the least weight of iron per kilometre. The pole weighs 810 kilogrammes (1,800 pounds). The height is calculated so that the wire is at least 6.50 metres from the ground. Porcelain insulators are employed, of the type which has been used with success on the long-distance line from Paderno to Milan. It is one of the best, both from a mechanical and an electrical standpoint. It is formed of two pieces, which, after testing, are assembled by means of a litharge and glycerine cement.

At different points on the line have been placed a number of transformer houses for reducing the main current to 3,000 volts and thus afford a local supply for different places. At present there are five of these cabins in operation. They are built in two stories, and the lower story contains the transformers with their switches, while the line connections and the lightning arresters are placed in the second story. From the Volvic cabin starts a 20,000-volt line, which is branched from the main circuit and goes to the Mozac cabin, where the voltage is lowered. One of the engravings shows the type of pole which is used on this section. It is designed to carry six wires, and a part of the section uses a lighter pole, which



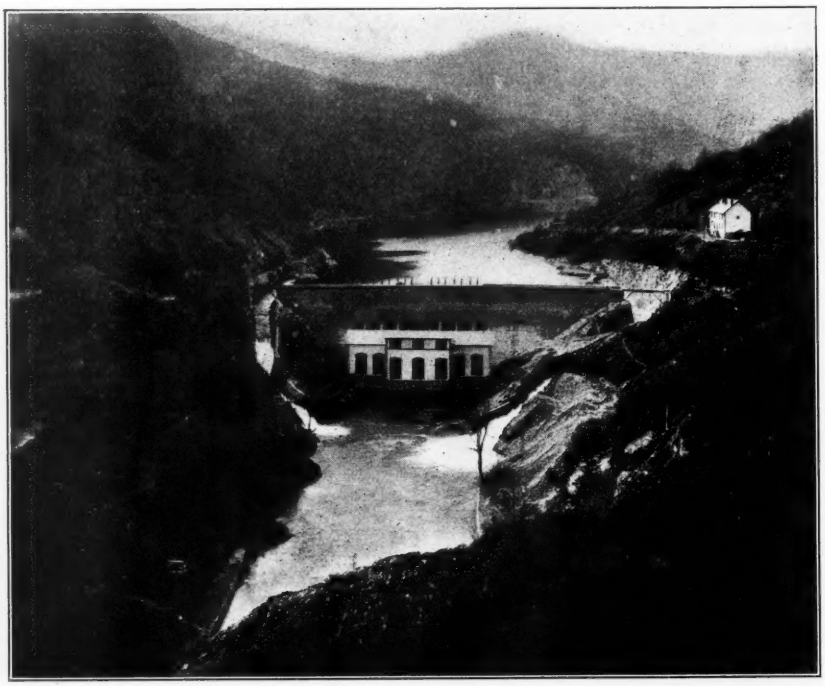
BRANCH LINE, SIOULE TRANSMISSION SYSTEM.

MAIN LINE, CLERMONT-FERRAND TRANSMISSION SYSTEM.

carries three wires. Underneath the line, where it crosses the road, is placed a protecting network formed of steel wires.

The high-tension lines, on reaching the town of Clermont-Ferrand, are brought to the substation, which lowers the voltage so as to supply the different sets of mains for the lighting and power within the town. The substation, of which we give two views here, one representing the step-down transformer and the other the main switchboard, is located in the grounds of the city gas works, in a fine building of modern construction. The interior arrangement of the station is remarkable for the good disposition of the cable circuits and the small amount of cable which is used, as well as for the great security which has been obtained for the machines and the attendants. Each set of three transformers is placed in a separate compartment whose walls are formed of armed beton. The high-tension current comes to the transformers by the upper part of these compartments, and each cable is separated from the next by means of cement partitions. The single-phase transformers are of the same type as is used in the main station. At present there are three groups of transformers installed in the substation. Each group consists of three single-phase transformers of about 375 kilowatts each, connected on the delta system. The voltage ratio in this case is 20,000 to 3,000 volts.

The automatic circuit-breakers, which are of the type already mentioned, working in oil, are placed in fireproof compartments, as well as the small transformers which are used for the electromagnets of the circuit-breakers. In the engraving will be noted the 3,000-volt switchboard of the substation. It is formed of thirteen white marble panels comprising two feeder panels for the lighting circuits, one alternator panel, three transformer panels for the lighting circuits, one panel for coupling the bus-bars, three transformer panels for the power lines, and three feeder panels for the same. The bus-bars, as well as all the switches and oil circuit-breakers with their transformers, are placed in armed cement compartments located in the basement of the station, and the apparatus is operated from the switchboard by a suitable mechanical device. This arrangement has been adopted so as to avoid having the high-tension current either on the front or the rear of the switchboard and also to economize space. The bus-bars are disposed in sections which are connected by a set of switches.



DAM AT THE SIOULE (FRANCE) HYDROELECTRIC PLANT.

The apparatus of the substation is protected by a system of lightning arresters which is laid out on the same plan as for the main station.

In the substation is also placed an engine and dynamo group, which is designed for the lighting circuits of Clermont-Ferrand and Royat in case an accident should happen to the high-tension line. This group is formed of a Willans-Robinson compound engine of the 450-horse-power type, direct-coupled to a Westinghouse alternator of 315 kilowatts, of the revolving field pattern, having the exciter mounted on the end of the shaft. This machine delivers three-phase current at 3,000 volts and fifty cycles. The engine is supplied by two Babcock & Wilcox boilers having 2,850 square feet heating surface each.

Asbestos—Its Occurrence, Exploitation and Uses.

An interesting report on asbestos has been made by Mr. Fritz Cirkel to Dr. Eugene Haanel, superintendent of mines for the Dominion of Canada. The report takes up the history, qualities, geological distribution and characteristics of asbestos, methods of mining and of dressing for the market, the cost of extraction, and describes the various Canadian mines. The production of asbestos in other countries is described briefly, and the commercial applications are dealt with at some length.

Asbestos is so different from any other material that its occurrence, mining and preparation for the market is an entire study in itself. The mineral was first mined in the Italian Alps at the beginning of the last century, but was looked upon only as a subject of interest to the mineralogists and geologist, and of little or no commercial value. It was not until the beginning of the seventies that the first attempts were made by London companies to exploit asbestos deposits in Italy. Concurrently with the exploitation of asbestos in Italy, a discovery of asbestos was made in the Des Plantes river region in the province of Quebec, and at the exhibition in London in 1862 a fine specimen of asbestos from this district was shown. Attempts to work these deposits were unprofitable. In 1877 asbestos was discovered in the serpentine hills of Thetford and Coleraine, and following closely upon this discovery, areas both at Thetford and Black Lake were taken up. Large forest fires had swept over this district, and subsequent rains had denuded the hills, leaving the rock bare. It was due to this condition that the discoveries were made and the working of the mines has been possible. For the ten years following these discoveries, the development of the industry was rapid, but it was soon found that primitive methods of extraction were inadequate and expensive, and many of the mines were shut down. The difficulties were finally met by mechanical devices, and there are now sixteen mines in operation, with a capacity of 3,500 tons of asbestos rock per day, and it is anticipated that the output of these mines will be largely increased in the course of the present year.

The name "asbestos," as commercially used, covers two distinct minerals, having in common only a fibrous structure and more or less fire and acid proof properties. These minerals are amphibole or hornblende asbestos, and serpentine asbestos

or amianthus, or Canadian chrysotile. In external appearance these are much alike, so much so that when they occur in long, slender prisms or in radiating masses, the mineral is called actinolite; but when found in long, slender, flexible fibres, easily separated, it is named asbestos. The difference between the two minerals —between good and bad asbestos—will be at once perceived when the fibres or long crystals are subjected to tearing, twisting and bending between the fingers. Good asbestos, applicable to the finer purposes of manufacture, will give up silky threads of great elasticity, while bad asbestos will split up into harsh and sometimes brittle fibres. The heat-resisting properties of both of these varieties of asbestos are approximately the same, so that when this characteristic only is required, the amphibole variety will give as good satisfaction as the chrysotile. Actinolite is mined in a small way, but the market is limited, and prices, as a rule, are not satisfactory.

Chrysotile asbestos is a fibrous form of serpentine, and occurs in this rock in small veins, laces or stringers. The main essentials of asbestos to render it of economic value are length, fineness and elasticity of fibre, tensile strength, flexibility and the power of fire-resistance. The Canadian chrysotile possesses all these qualities, the length of the fibre being one of the principal factors which determines the different grades. As to its fire-resisting properties, temperatures up to 3,000 degrees Fahrenheit are easily withstood, while for some varieties a temperature of 5,000 degrees Fahrenheit will produce no visible effects.

In a geological sense there are two kinds of asbestos—the supplies belonging to the Laurentian formation, and the Templeton area north of Ottawa, in connection with a certain serpentinous limestone, and the asbestos of the eastern townships, more particularly confined to the serpentine areas of the mountain belt which extends from the boundary of Vermont to the extremity of Gaspe Peninsula.

The serpentine in which asbestos occurs in the Laurentian formation is closely associated with crystalline limestone, which traverses the gneiss formation in the form of bands. In the eastern townships serpentine is found in bands sometimes a few yards in breadth, interstratified with slates and sandstones. In the eastern portion of the peninsula of Mount Serpentine some veins of asbestos in a band of serpentine have been found associated with hornblende rock.

The veins in the asbestos-bearing rock occur without any special arrangement, intersecting each other and the mass generally in every direction, and generally forming straight lines. Sometimes they split up in several smaller veins, or coalesce and form a larger vein. The thickness of the veins varies from mere threads up to several inches. The largest bulk of the asbestos mined is between one-quarter and one-half inch in length. The longer fibre is often divided in the middle by a seam of serpentine carrying magnetic or chromic-iron ore. As a rule, in most of the mines the asbestos can be easily separated from the rock, but in some veins the fibre appears to be frozen to the rock, its complete separation being difficult.

Discoloration of the asbestos and alteration of the fibre itself can be observed. These are due to three causes: the influence of the weather and the action of the water; to large forest fires; and to the presence of intrusive dikes.

Several theories regarding the origin of asbestos have been advanced. Mr. Pratt, of the United States Geological Survey, thinks it can be conclusively shown, in nearly all cases, that the serpentine in which the chrysotile asbestos is found is of igneous origin. During cooling these veins solidify, first along contact with the rocks. The outer portions thus cool more suddenly than the interior, and there would therefore be a tendency to develop cracks and parting planes. In the end these cracks would be filled with serpentine deposited from aqueous solutions from their walls, and the resulting fibrous structure of the serpentine filling these seams represents the nearest approach to true crystallization that the mineral serpentine assumes. It is probable that this crystalline asbestos may have been formed some time before the complete alteration of the primary rock into serpentine. With very few exceptions, all the fibres of the asbestos are standing nearly at right angles to the sides of the seam, which would conclusively show that they were not formed by any sheering movement of the rocks.

Dr. Ells, of the Geological Survey of Canada, thinks that the asbestos veins which traverse the serpentine in all directions owe their origin to fissures which have been formed in the rock mass as the result of one of the several periods of movement. The vein asbestos appears more naturally to have been produced by a process of segregation of serpentinous matter, from the size of the fissure, very much as ordinary quartz, in many mineral veins, is known to have been produced, the segregated or infiltrated matter gradually filling the original fissure, and meeting at or near the centre. Merrill holds that the crevices in the serpentine are due to shrinkage. These cracks have been filled as though the crystal fibres had been pushed outward from the two walls until the extremities met.

Asbestos, in general, is mined in open quarries. This method has disadvantages, since it requires the removal of all rock in the quarry, it can not be used during severe weather, and it curtails the land available for dumping. The advantages, however, of this method outweigh the disadvantages. They are: easier supervision, no ventilation troubles, it is easy to lay out the works, timbering is unnecessary, and all of the asbestos in the deposit may be mined.

The first step in opening a quarry is to remove the surface soil, and then the rock is taken away in a series of benches, stopes and terraces. Hand-drilling is still used in the smaller mines and for prospecting, but in all the larger machine drilling is in vogue.

After breaking down the wall of rock the material is roughly separated into four classes: the long asbestos fibre and pieces of rock containing this, the rock containing the shorter fibre, the fine material and scrapings of the pots, and the dead rock. The material containing the long fibre is sent to the cobbing sheds; that containing the short fibre is sent to the mills. The fine material must first be dried.

Dressing asbestos for the market is done in two ways: the long fibre is dressed by hand, the adhering rock being broken off by hammers. The refuse from the cobbing shed is sent through the mill with the lower grades of material. The cost of cobbing varies from $6 to $8 per ton. The mechanical treatment used for the shorter fibre consists in crushing the material in a rock crusher, passing it then through a rotary drier to dry off the adhering moisture, then passing it through a rotary crusher, and next through a cylindrical fiberizing machine. From here the material is passed to the screens, the sand taken out, and the loose fibre carried by an air-blast to a collector. The remaining rock and fibre from the shaking screens are carried into a suction apparatus in which two propeller fans are driven in opposite directions at high speed. This tears apart all the remaining fibre, and allows it to be carried off by an exhaust fan. The second part of the operation consists in dividing the asbestos into two grades. The fibre is passed through a revolving screen with arms moving in opposite directions. The tailings from this

screen are passed over a second screen, and all the fibres remaining in the sand are removed.

To extract the iron which may be in the crushed material, electromagnets are placed over the discharge from the crusher.

The cost of extracting asbestos and preparing it for the market is estimated to be $17.41 per ton. A large item of this is for fuel, and since no steam-saving apparatus is employed, it is thought that this could be reduced, lowering the cost to $14.50 per ton.

The amount of asbestos produced in 1904 in Canada was 35,068 tons, valued at $1,154,566. In addition to this 13,087 tons of asbestic were produced, valued at $13,006. Asbestic is formed by grinding waste asbestos fibres and serpentine into a fine powder.

Asbestos is produced in other countries, that in the United States coming principally from Massachusetts and Arizona. Small quantities are also produced in Georgia and Connecticut. A deposit has been discovered in Wyoming, and there are large deposits of amphibole asbestos in North Carolina, Wisconsin and Vermont.

Deposits of asbestos have been known for some time in Newfoundland, but they are mostly of the short variety.

Asbestos has been mined in Italy for some time, but when the large Canadian deposits were opened the Italian producers found they could not compete with the Canadian material.

Asbestos occurs in various parts of Russia, though the deposits are worked in but one district, and this is at Ekaterinburg. Asbestos occurs also in Queensland and South Australia, in New South Wales and New Zealand. These deposits have been more or less worked, but apparently without much profit. In Africa asbestos occurs in West Grikuland, and is worked with native labor. This asbestos apparently has many good qualities: it is cheap to extract, has a white color, and a strong fibre; yet the business has not been profitable.

Asbestos was first used commercially in 1868 and 1869, in connection with the manufacture of roofing felt and cement. Early attempts to spin this fibre were not successful, but the difficulties have now been overcome, so that a single asbestos thread, weighing not more than one ounce per hundred yards, may be made, which has a pretty fair strength. In its spun state it is used largely in the shape of yarn for packing valves, etc., for which use it has many advantages. Asbestos ropes for use in fire departments are of two kinds—one entirely of asbestos, and the other having a core of steel. During tests made by the German government with a wire-cored asbestos rope it was found that a three-quarter-inch rope, with a steel-wire core, carried nearly 2,000 pounds, and then only one of the seventy-odd strands of which the rope consisted broke. The asbestos rope without the steel core was sufficiently strong for firemen's purposes. A half-inch rope will carry 200 pounds, and a three-quarter-inch rope, over 300 pounds.

One of the largest uses for asbestos is in the manufacture of steam-pipe coverings and for heat-insulating purposes generally. In the form of asbestic it is used largely for fireproofing materials. It is used in the form of millboard in constructing electrical machinery, and a composition for the insulation of metallic conductors has been made which consists of a layer of asbestos covering the surface to be insulated, and a coating of oil combined by boiling with litharge.

Other uses of asbestos are for heat insulation in cold storage warehouses as a filter medium, and in the laboratory. Asbestos articles are naturally hygroscopic, but may be rendered waterproof by coating them with chrome alum, alum glue, or chrome-alum glue. When the articles have to be subjected to a high temperature they may be coated with water glass or porcelain enamel.

To prevent the disintegration under the action of liquids, sheet asbestos, without the addition of any binding material, is heated to a temperature below that at which vitrification occurs. This is done in a bath of molten aluminum of from 600 to 700 degrees centigrade. Sheet asbestos treated in this way forms an excellent material for diaphragms and the electrolytic production of alkali.

A very important use of asbestos cloth is for fire curtains for theatres, for which purpose it has many advantages over the steel curtain. It is also used in the preparation of fireproof paints which are suitable for rough woodwork.

The report concludes with an abstract of the mining law of the province of Quebec, and a bibliography of the subject.

Comparative Tests of Incandescent Lamps.

Some tests were recently made of five makes of French lamps by MM. Lauriol and Janet, who have communicated the results in a recent note to the Société Internationale des Électriciens. These lamps were for two voltages—110 and 220; and in three sizes—five, ten and sixteen candle-power. In all 260 lamps were tested. The following are the results of the tests: the 110-volt lamps showed a mean consumption of 3.62 watts per candle at the start, and 3.87 watts per candle-power at the end of the test. The 220-volt lamps consumed 4.4 watts per candle at the start, and 5.19 watts at the end. The tests were made at the instance of the Paris electrical commission.

TESTS ON INTERURBAN SINGLE-PHASE EQUIPMENTS.[1]

BY GRAHAM BRIGHT.

The advent of the successful single-phase alternating-current railway has made it necessary to conduct a large number of tests to determine accurately the various characteristics of the system in actual service. Tests of this nature are considerably more difficult to make on an alternating than on a direct-current system on account of the larger number of factors that enter into an alternating-current system, and also on account of the greater sensitiveness of alternating-current instruments to changing currents, especially on a moving car.

The usual method of making a test on a moving car is to lay out a given length of run on a level straight track and then to make a run with the car, just as near as possible like it would be made in actual service. The rate of controller notching is decided upon before the test and also the point at which the current is to be cut off, from which point the car is allowed to drift until the brakes are applied. Instrument readings are taken at predetermined intervals. These readings are afterward corrected, tabulated and plotted in the form of curves. These curves show very plainly just what takes place from the time the car starts until it reaches the end of the run, and are somewhat analogous to a steam-engine indicator card, but of course cover more ground.

When testing a direct-current car, readings may be taken at intervals as close as every two seconds, but when testing an alternating-current car, it is not advisable to try to take readings at closer intervals than every five seconds, owing to the more sensitive characteristics of alternating-current instruments.

The actual readings necessary in testing an alternating-current equipment are those which give the trolley-volts, trolley-amperes, trolley-kilowatts, motor-volts, motor-amperes, motor-kilowatts and speed. From these readings the apparent trolley-kilowatt, apparent motor-kilowatt, trolley-power-factor and motor-power-factor can be calculated. A timekeeper is also necessary who carries a stop-watch and rings a bell or blows a whistle at intervals to notify the observers just when to take their readings. If possible, there should be a second timekeeper to call out the number of each signal, so that each observer will get his readings down in the proper place. When long tests are made over a complete section of any system, an

[1] The *Electric Journal*, November.

additional observer is needed to mark locations, position of controller-handle, and the lengths of stops.

In selecting observers for a car-test, men should be chosen who are familiar with test work and instrument-reading, so that they can read an instrument accurately at a glance. Several preliminary tests should be made when the observers are first brought together so as to make each man familiar with his surroundings and the instrument he is to read.

For the measurements of current and power, from which the accompanying curves were plotted, Westinghouse alternating-current portable instruments were used. Dead-beat alternating-current voltmeters were used to measure voltage. Speeds were obtained by means of a direct-current magneto-generator, driven by one of the car-wheels. From this magneto-generator, leads were run up into the car, and the observations made on a direct-current voltmeter. All instruments were carefully calibrated before or after any important tests.

Two tests taken recently are shown in Figs. 1, 2, 3 and 4. Curves 1 and 2 show a test, No. 10, on a 49.4-ton interurban car equipped with four seventy-five-horse-power Westinghouse single-phase alternating-current railway motors geared for a speed of about fifty miles per hour. This test extended over a run two miles in length. The controller was operated to the full-on position in about fifteen seconds, and was thrown off about 3,000 feet from the end of the run. The car was allowed to drift about 2,500 feet, and then the brakes were applied. In looking at the speed curve, the acceleration for the first thirty seconds is seen to be 0.7 mile per hour per second. In another test on this car the initial acceleration was increased to one mile per hour per second by operating the controller a little faster.

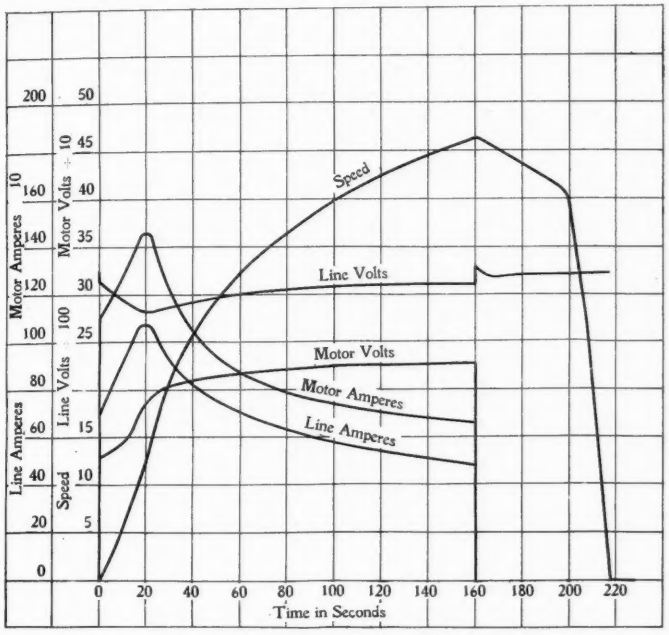


FIG. 1.—TESTS ON INTERURBAN SINGLE-PHASE EQUIPMENTS.

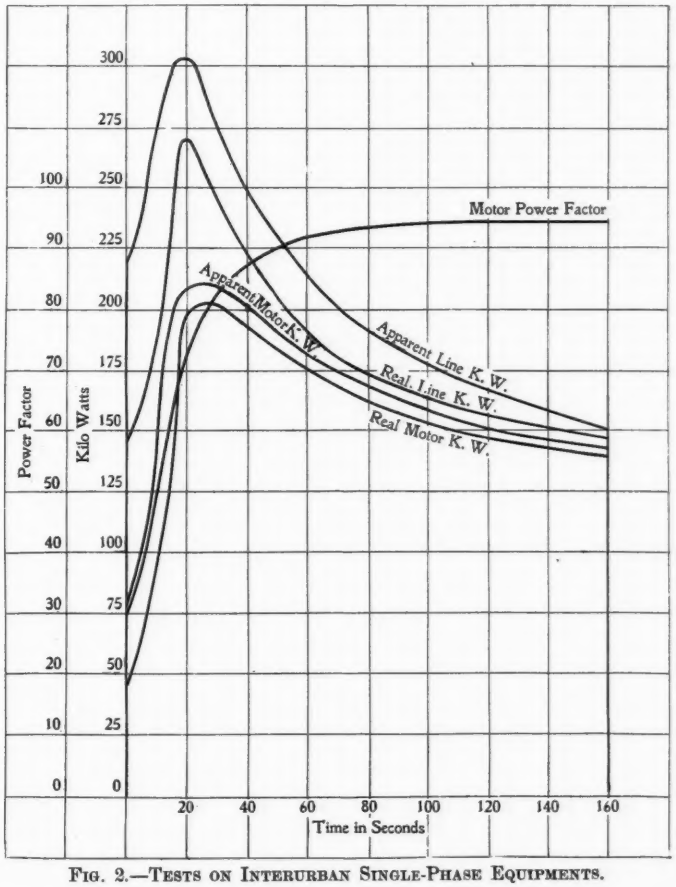


FIG. 2.—TESTS ON INTERURBAN SINGLE-PHASE EQUIPMENTS.

In this test the maximum apparent line-kilowatt was about 350. An acceleration of one mile per hour per second is higher than is ordinarily required with cars of this weight and gearing. The decrease in speed during coasting and braking is shown very clearly in the curve. The rate of acceleration can be obtained at any point by taking a tangent to the speed curve at that point.

The difference between the line real kilowatt and motor, real kilowatt curves represents the losses in the transformer and car-wiring.

The kilowatt per car-mile and watt-hours per ton-mile can be calculated from the average kilowatt which is obtained by integrating the line real kilowatt curve and dividing by the entire time of the run including the stop.

The actual power drawn from the line is very low as the car starts, but rises rapidly, reaching a maximum a little later than the maximum for the apparent kilowatt.

The power-factor is rather low at the start, but rises very rapidly, passing a value of eighty per cent in less than twenty seconds, and soon reaching ninety-one per cent in one test and ninety-four per cent in the other. The average power-factor

will run from eighty to eighty-five per cent in these tests and with longer runs at full speed would be considerably higher.

The average power-factor may be obtained by dividing the average real kilowatt by the average apparent kilowatt.

The actual heating of the motors and transformers depends upon the value of the mean square current. The square root of the mean square current can be readily obtained by plotting the square values of the current readings. This curve is then integrated and divided by the total time of the run, including the stop. The square root of this value will be the square root of the mean square current. This result is the value of the constant current which would produce the same heating as the actual varying current. This value will determine whether the motors and transformers are working above or below their capacities.

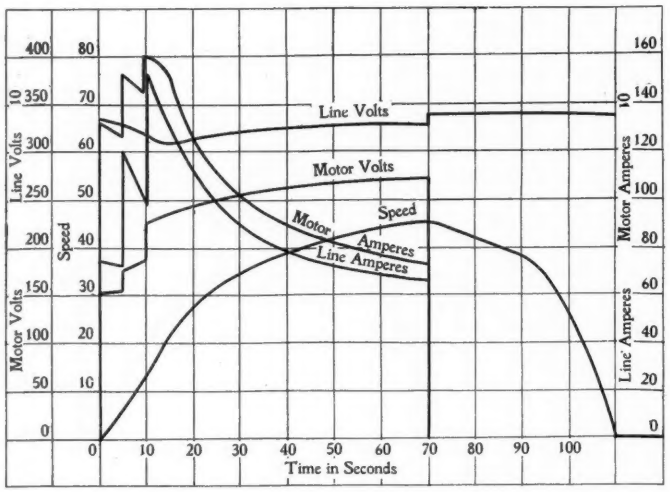


FIG. 3.—TESTS ON INTERURBAN SINGLE-PHASE EQUIPMENTS.

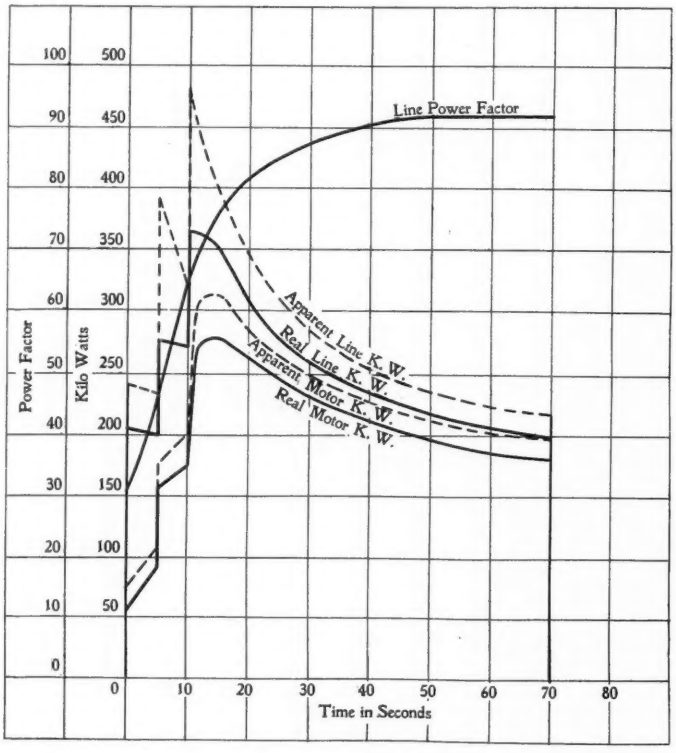


FIG. 4.—TESTS ON INTERURBAN SINGLE-PHASE EQUIPMENTS.

The sudden rise in the line-voltage curve at 160 seconds (Fig. 1) is due to the line-current being cut off, which allows the voltage to rise owing to the decrease in line drop. The lowering of the load on the engine and generator will also cause the voltage to rise a little.

The gradual rise of the motor-volts after the controller is on full, is due to the decrease in the line and transformer drop.

Figs. 3 and 4 show a test, No. 9, on a somewhat lighter car with the same equipment and geared for about the same maximum speed. The length of run in this case was only one mile, which is a shorter run than the equipment is intended for. Readings were taken for each of the three notches in the controller. A much higher acceleration was used in this test, which accounts for maximum values of the kilowatt-curves being somewhat higher than in the previous test.

Notwithstanding the fact that a considerable drift was allowed, a schedule speed of thirty miles per hour was obtained. This is a very high schedule speed for such a short run, and accounts for the watt-hours per ton-mile being higher than it is for the other test.

Curves were calculated and laid out for operation by direct-current motors using the same weight of car, the same length of run, same schedule and same maximum speeds. The watt-hours per ton-mile found were approximately the same as were obtained in the tests just described.

A further test of importance on an alternating-current equipment is a service test. For this test a typical run is laid out from which the square root of the mean square current can be calculated. This run is repeated over and over again for about eight hours to determine the suitability of the apparatus for regular service. At intervals, temperature readings are taken on the transformer windings and motor fields. At the end of the run, temperatures are also taken of the armatures and commutators. This test determines the actual capacity of the motor and transformer for any given set of conditions.

There has been considerable scepticism among engineers as to whether a car could be accelerated rapidly enough when equipped with and operated on the single-phase alternating-current system. A number of acceleration tests have been made on different cars, the controller being operated at various rates of speed, and no difficulty has been experienced in obtaining initial accelerations as high as two miles per hour per second.

It is also possible with the alternating-current system to throw the controller on full at once without injury to the motors.

Report on Telephone and Telegraph Development in Australia.

Three interesting reports were made recently by Mr. John Hesketh, electrical engineer in the portmaster-general's department at Queensland, Australia, to the parliament of the commonwealth of Australia. The first of these deals with matters investigated by Mr. Hesketh during his recent tour in America and Europe; the second deals with the message rate, or measured service or toll system of charging for telephone services; and the third is a supplementary report on the automatic telephone exchange system.

The first report deals with the present position of the telephone art, and gives suggestions as to the action desirable for the proper development of the telephone systems of the commonwealth of Australia. It takes up first the development policy, and shows that the lowest rates for service are not always the most desirable, since they are apt to go with poor service. It is urged that more attention be paid to securing rural and country subscribers, and less to city development, since the latter naturally takes care of itself.

Under the question of telephone charges it is held that the flat rate is not desirable, since the small user pays more in proportion than the large, and this discourages the former. It is suggested that a scheme of charges be adopted by which a certain minimum will be charged, sufficient to cover the cost of installing the station, and that a message rate be added to this. For convenience, however, it seems desirable to make the minimum charge large enough to cover, say, two messages per day, all messages above that to be paid for at a low rate.

The question of adopting measured-service rates is complicated by the present method of flat-rate charges, which can not be dropped immediately; but it is advised that all new subscribers be taken on a measured basis; that the contracts at present standing be continued as they are, but that they be renewed only on a measured basis.

In estimating the rates to be charged, comparison is made with those of other countries. Attention is again called to the fact that rates are necessarily higher where the exchange is large. It is said that the service of the New York Telephone Company is an excellent example of good service. "There is no better telephone service in the world, but the rates are the highest I know of. Every detail of this company is admirably carried out, and the users do not grudge the seemingly heavy payment, because they receive such splendid service."

Under the question of party lines, it is held that these are necessary for rural development, and that for further development of the Australian systems party lines should be adopted along with the adoption of a measured service.

Another potent factor in assisting telephone development is the establishing of pay-stations. These add considerably to the revenue of the office, and it is urged that the telephone authorities seek out desirable places for such stations, and install them without waiting for a request.

The following standards of traffic are said to be attainable in any well-conducted system: all calls should be answered within an average of five seconds; the connection should be completed with the called subscriber, if connected to the same exchange, in thirty seconds; if connected to another exchange by junction lines, in thirty-five seconds. On conversation being concluded, and the proper signal given, it should be possible to call the exchange again in ten seconds. These standards are said to be far from the highest attainable, and should be aimed at in all the exchanges in Australia.

The importance of providing good accommodations for the operators, and of training them before allowing them to enter the exchange proper, is emphasized.

Under the head of construction methods it is suggested that a standard stoneware conduit be adopted as the best practice. Cast-iron pipe might be used where the number of conduits is small. Braiding laid over the lead sheath of cables is unnecessary, and the addition of three per cent of tin to the lead is likewise unnecessary. Single paper insulation should be adopted as standard. Tinning the conductors is not necessary, and for short lines light conductors, say, No. 23 (standard wire gauge) could be employed satisfactorily. Dry air apparatus should be adopted in all large centres, as this reduces the cost of jointing and of removing faults. Attention is called to the new methods of loading lines with impedance coils. At the present time, it is said, Australia does not need such loaded lines, but the system should be watched carefully, since such lines may be required in the near future. Mr. Hesketh advises the use of glass insulators for Australian telephone work, since they can be made locally, are cheaper than porcelain, are as good as the latter under Australian conditions, and equally efficient for telegraph work.

He advises that an effort be made to adopt a set of standard patterns for use in telephone instruments throughout Australia. It appears desirable that aerial work in all large centres be abandoned.

It is estimated that the cost of construction in any large centre of Australia for a fully equipped modern service would be from $150 to $175 per direct line provided for.

Attention is called to the important technical problems which are constantly arising in telephone work, and it is advised that a staff of experts be built up for handling these problems. The laying down of standard methods for application to Australian conditions would be a work of some time, but it is one that it is most desirable should be put in hand at once.

In fixing a standard for transmission in Australia, regard is had not only to the present limits of speech within Australia, but to the possible extension of trunk lines. At the present time 200 miles is the longest distance over which subscribers in Australia usually talk, but there is under consideration a line from Melbourne to Sydney—600 miles—and eventually this line may be extended to Adelaide, making it 1,200 miles in length. Two hundred miles is regarded as too low for a standard, but 1,200 miles is too high. It is recommended that 800 miles be adopted as the length over which commercial speech may be conducted. For Tasmania, where distances are less, it is recommended that a standard of 200 miles be adopted.

The benefits of the common battery system are pointed out, and it is recommended that extensions of present pattern switchboards in all state capitals and other large centres cease, and that specifications be prepared for the common battery equipment necessary to accommodate new subscribers in such places.

It is recommended that the following party-line services be adopted: two-party, selective, and, if possible, lockout; four-party, semi-selective, and non-lockout.

A study should be made of each of the telephone centres, excepting only those having fewer than 500 subscribers, and only such work as is quite unavoidable for the continuance and maintenance of every existing service therein shall be carried out. Any new work shall, as far as possible, form a part of an improved, complete scheme laid down on modern lines. The present specifications for materials and methods of construction must be revised and brought into closer conformity with modern practice, and the operating methods of the several larger exchanges

should be analyzed and altered where necessary.

It is earnestly recommended that a commercial policy be adopted by which the telephone systems will be rendered self-supporting. With proper management, whatever capital is invested will not only earn working costs, maintenance, interest and sinking fund, but a margin beyond; and when this has been demonstrated there will be little difficulty in obtaining the capital necessary for extending the system. To this part of the report is appended a schedule of rates in various large telephone centres of the world.

The second section of this report deals with recent telegraphic developments in America and Europe. Attention is called to the use of mechanical transmitters. Surprise is expressed that in America so little use is made of the duplex and quadruplex systems.

It is recommended that a study be made of the extent to which telegraph switchboards can be employed efficiently and economically in Australia; that a study be made of the cost and economy resulting from the introduction of motor-dynamos in all state capitals, in place of primary batteries; that consideration be given to the effective daily load or work of an operator on different circuits, and a study made of the steps to be taken to increase such effective daily load, whether by offering bonuses or introducing different methods. It is recommended that at the large operating centres, mechanical transporters for carrying messages be introduced, and that permission be given to operators to use certain mechanical transmitters. The use of box sounders on local and suburban lines is recommended.

The third section of the report deals with wireless telegraphy, and describes briefly the different receivers employed. It is thought that a wireless system could be applied in a good many cases in Australia as a means of communicating between the mainland and neighboring islands. Such a system should be available for unrestricted use. It should be capable of tuning so as to enable communication to be maintained with stations of widely different tunes. This is essential because, although the stations will primarily be erected for communication between different points, they will eventually be required to take messages from ships which may be fitted with apparatus of various kinds.

In the fourth section of the report, methods of simultaneous telegraphy and telephony are taken up. The following generalization are made: there are two methods which might be employed in many cases advantageously. They are those in which metallic-circuit telephone lines operate with a telegraph superimposed, and where two metallic-circuit telephone lines operate with a third telephone superimposed. For distances less than 100 miles, a single-wire telegraph circuit with telephone superimposed, or two single-wire telegraph circuits with telephone superimposed, may be used; but much can not be hoped from these two systems for longer lines. The former of these two, it is thought, may be found of use in country districts, and the latter for tentative lines where the revenue to be obtained is uncertain.

The question of injurious affection of telegraph and telephone circuits by heavy currents is taken up in the fifth section of the report. The tendency in general is for the telephone departments to do more toward self-protection aerially. In large centres conflict is unnecessary, as underground systems are employed. For the protection of underground wires from electrolysis, moderate regulations, on the lines of those already adopted by the Australian conference, are recommended. The responsibilty of accidents in case of injury to third parties has as yet not been decided.

THE MESSAGE RATE OR TOLL SYSTEM OF CHARGING FOR TELEPHONE SERVICES.

The second report of Mr. Hesketh is supplementary to the first, and deals more particularly with the message rate or toll system of charging for telephone services.

The two following conclusions, it is stated, can not be too emphatically urged upon the attention of the minister: first, that even with the present imperfect appliances, the introduction of a measured-rate system of charging will effect an immediate and substantial improvement in the service of checking indiscriminate and unlimited use of the lines; second, that even if an improved common battery metallic system be introduced at great expense, the service will still be unsatisfactory so long as the present flat rates are maintained. It is held that the present systems would grow, within certain limits, if the existing scale of charge is maintained, but as they grow, the disabilities would increase, and the class of service would deteriorate. This unfortunate state of affairs can only be prevented by the adoption of a different system of charging.

THE AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

The third report is also supplementary to the first, and deals at some length with automatic telephone exchange systems. After referring briefly to the various systems proposed and in use, Mr. Hesketh quotes the following opinion from his earlier report, and then goes more into details:

"I have most seriously and carefully considered the question, and am obliged to report that there is not in operation today any system of automatic or semi-automatic telephone exchange that I could recommend to the minister to adopt for the large centres in Australia. I desire, however, that this should not be taken as a wholesale condemnation of automatic systems. On the contrary, I consider that we must look to automatic assistances of manually operated boards for future developments. What I am compelled to believe is that at the present date the highest development of telephony is the common battery system as operated so extensively and successfully by all classes of users practically throughout the whole of the United States.

"It must not be forgotten that the operation of the common battery switchboard is very largely automatic, and is tending to become more so; but the automatic features are under the care and control of trained operators, where they can be applied to the best effect.

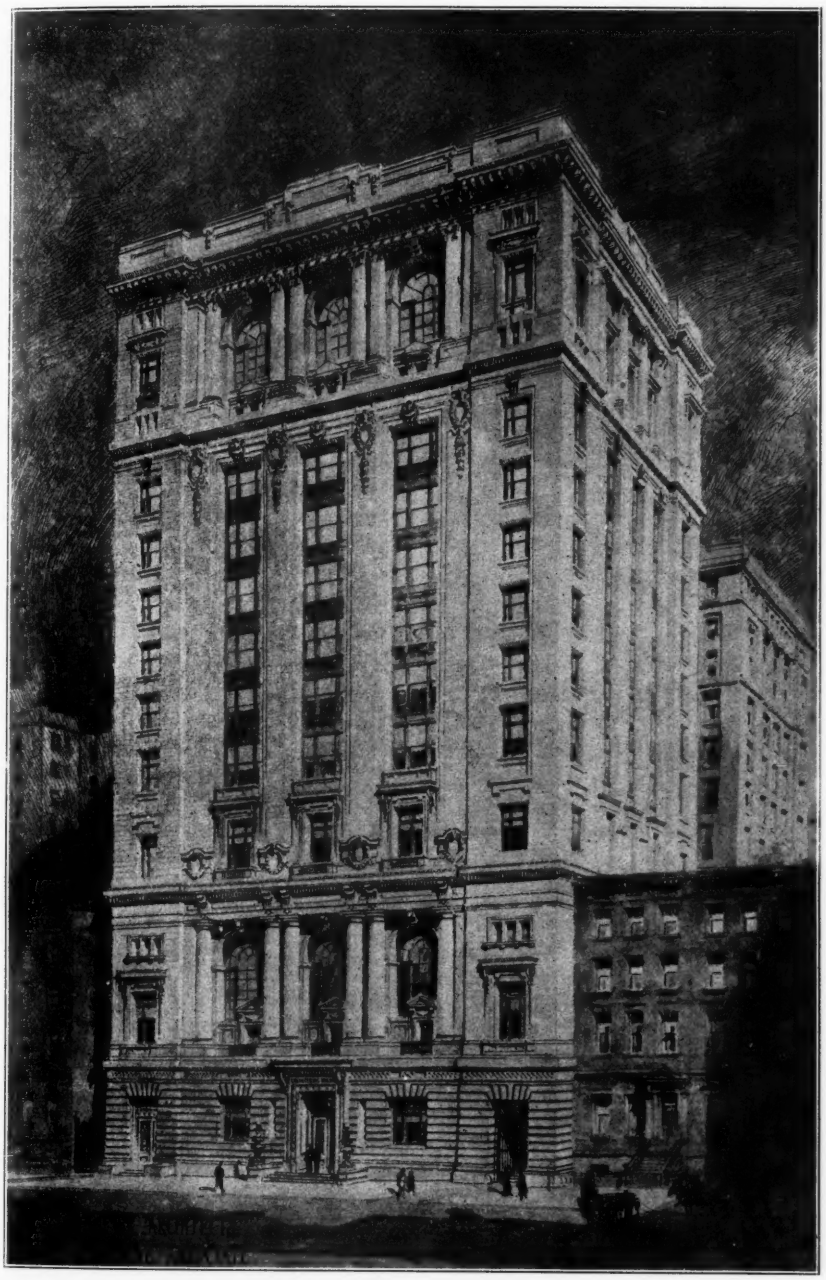
"I have no hesitation in saying that the common battery system will enable an administration to do more in building up a permanently satisfactory system than any other method in use at the present date. Further, there is nothing to indicate that this system will, if adopted, fail to give facilities for the adoption of newer methods as they may be devised."

As regards the first cost of automatic systems, from the data obtainable, it is thought that this would be about the same for the common battery system. Evidence as to the cost of maintenance is conflicting. It is said that the liability to disarrangement of the subscriber's apparatus is greater than in the common battery system, and although the manufacturers of apparatus express the conviction that they could reduce this number of faults, Mr. Hesketh reports on conditions as he found them. It is held that with the automatic system the inefficiency of junction-line working is strongly emphasized, and there are several directions in which the automatic system falls short of meeting ordinary telephone requirements. For example, a separate manually operated system is required for trunk-line working, and at the present time the automatic system can not complete busy calls. Further, it is believed that the introduction of an automatic system would not be advantageous for telephone development in Australia. On the other hand, the common battery system is now no longer experimental. It has been perfected in details since its adoption in 1896, and is used in systems varying from 500 to 150,000 subscribers. It is flexible, and lends itself to the needs of small and large centres. While largely automatic in operation, it retains the personal element so far as is necessary to ensure perfect telephone operating. It enables party lines to be worked perfectly, and lends itself to every requirement of the measured service system.

Report of Committee on the Engineering Building.

The public competition instituted by the joint committee for the selection of architects for the planning and erection of the building presented by Mr. Andrew Carnegie for the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, and the Engineers' Club, resulted in the presentation of twenty-six sets of plans for the building. After a careful examination of these plans, the committee appointed Messrs. Hale and Rogers and Henry G. Morse, associate, architects for the three engineering societies, and Whitfield & King, architects, for the Engineers' Club.

The frontage of the engineering building on Thirty-ninth street, between Fifth and sixth avenues, covers five city lots, or 125 feet front, and 100 feet deep. The building utilizes 115 feet of the 125 feet front, and 90 feet of the 100 feet depth, the lot numbers being twenty-five to thirty-three.



THE PROPOSED ENGINEERING BUILDING, WEST THIRTY-NINTH STREET, NEW YORK CITY.

The engineering building must meet requirements in five directions:

1. It must serve the convenience of each of the individual societies, which enter the building as founders.

2. The building must supply to the three national founder societies and also to such other organizations as may be invited to participate in its benefits as associates, such meeting rooms and auditoriums as will be required for the annual meetings, the public reading and discussion of papers, and for scientific lectures and demonstrations. In view of the number of participant societies for which provision has been made, the committee has thought it advisable to arrange for a number of assembly rooms suitable for various uses.

It is expected that there will be a great demand, especially for the small meeting rooms, for scientific purposes. They will be supplied with electric current, with compressed air and with gas and water. The meeting rooms of all sizes will be fitted for the use of the projection lantern, and will be unique in their completeness for the purposes for which they are intended. The board rooms of the society floors will be large enough for the holding of small professional meetings when occasion may require.

3. A crowning detail in the planning of the building has been the provision on the two upper floors for the libraries of the various societies. It is the purpose of the societies so to administer the library of each that by bringing them together there shall be created a working and reference library of the highest possible value and completeness as respects engineering science and practice, and which shall be unequaled anywhere.

4. The building is also to furnish office accommodation for a large and continually increasing number of societies which have engineering or some other department of science as their principal object; such as for example, the New York Electrical Society, the Society of Naval Architects and Marine Engineers, the Heating and Ventilating Engineers, the American Gas Light Association, the National Electric Light Association, the Society of Chemical Engineers, the Association of Edison Illuminating Companies, and many others. For these organizations the building will offer office areas of varying sizes, whose arrangements will be adjusted to the requirements of such participants as shall hereafter be made known. Such participants will have use of the auditoriums of the desired size.

5. The building must also serve as a business office for the founder and the associate societies.

By a business arrangement formed under legal advice and forming part of the deed to the property to the east of the

building, a restriction has been placed which prevents the erection on that lot of a building more than sixty feet high. This restriction runs with the land and secures light and air for the building on its eastern front above the third floor. The westerly wall is built ten feet within the property line, so that openings for light and air should always be left on that side and on the rear, even if high buildings should be hereafter built on adjoining property to the west and the north. The committee contemplates finishing the building on all four sides and not merely on the south façade, in order that its monumental character may be seen and recognized from every point of view.

The contract for construction was signed in July, the excavation for the foundations was started at once, and the work of construction has now commenced. The contract limit is fifteen months to date of expected completion.

The report is signed for the three national societies as follows:

Chas. F. Scott, Bion J. Arnold, S. S. Wheeler, American Institute Electrical Engineers.

C. W. Hunt, James M. Dodge, F. R. Hutton, American Society Mechanical Engineers.

A. R. Ledoux, Charles Kirchhoff, Theodore Dwight, American Institute Mining Engineers.

Industrial Advertising Managers Dine.

The Technical Publicity Association, whose members are the advertising managers of machinery and electrical manufacturers east of Ohio, dined and held an open meeting at the Aldine Association, 111 Fifth avenue, New York city, on Friday, December 8. Mr. George H. Gibson, a former secretary of the association, delivered an address on "Lost Motion in Machinery Advertising." This was followed by an informal discussion.

Among the companies represented at the dinner were the Ingersoll-Rand Company, New York; Niles-Bement-Pond Company, New York; General Electric Company, Schenectady, N. Y.; Crocker-Wheeler Company, Ampere, N. J.; Sprague Electric Company, New York; De La Vergne Machine Company, New York; John A. Roebling's Sons Company, Trenton, N. J.; M. H. Treadwell Company, New York; Westinghouse Companies, Pittsburg, Pa.; New York Edison Company, New York; Yale & Towne Manufacturing Company, New York; American Wood-Working Machinery Company, New York; B. F. Sturtevant Company, Boston, Mass.; H. W. Johns-Manville Company, New York; Holophane Glass Company, New York; Sawyer-Man Electric Company, New York.

THE MADISON SQUARE GARDEN ELECTRICAL AND MECHANICAL SHOW.

A VERY INTERESTING EXPOSITION OPENED WITH A LARGE ATTENDANCE TUESDAY, DECEMBER 12.

The Madison Square Garden Electrical and Mechanical Show was opened in Madison Square Garden at 8.30 P. M., December 12, by Dr. George F. Sever, the director of exhibits. Dr. Sever welcomed those attending the exposition, and announced that President Roosevelt had started the machinery of the exposition in motion by pressing a golden key which had been used in opening the Chicago exposition, the exposition at St. Louis, and two other historic American expositions. This key will be on exhibit, it is understood, later in the week.

New York city has always contributed a host of persons curious to understand the developments of electrical science. Not only was there a large number of people present, but there was the keenest interest manifested in the various devices on exhibition.

A notable feature of the early hours of the exposition was the gathering of so many representative men, numbers of whom were intimately connected with the history of electrical development in this country. Among these were seen Leo Daft, Bion J. Arnold, Ralph W. Pope, George Hamilton, Frank E. Kinsman, Arthur Vaughan Abbott, Frank Sprague, Cary T. Hutchinson, Dr. W. E. Goldsborough, Michael I. Pupin, Calvin W. Rice, Phillip Torchio, John W. Lieb, G. Herbert Condict, G. C. Harding, W. C. Andrews and many others well known to the electrical fraternity.

The lighting features of the exposition hall were very interesting, and the fact that almost without exception every exhibitor had some form of illuminated sign, made a picture of great attractiveness.

The exhibit of the New York Telephone Company was the centre of interest of a throng of the curious. Not only were the modern instruments and the "theatrephone" well patronized, but every one apparently took a great interest in the historical exhibit.

The American DeForest Wireless Telegraph Company exhibited a portable wireless telegraph outfit and a wireless signal equipment similar to that sent to Japan for the use of the Japanese army during the recent conflict with Russia.

Adjoining the exhibit of the Wireless Telegraph Company, the Exhibition Company of America had its reception booth, where information was disseminated and where copies of the beautiful electrical show poster were placed on sale.

The Victor Talking Machine Company, of Camden, N. J., made an elaborate exhibit of talking machines.

The Gold Car Heating and Lighting Company, New York city, demonstrated the advantages of this form of electric heating and placed before the public a number of typical pieces of apparatus.

The Vandyck-Churchill Company, New York city, exhibited a head-geared lathe and several other motor-driven machine tools.

The Bender-Martin Company, New York city, exhibited the "Advergraph," a device for both indoor and outdoor advertising purposes.

A very interesting exhibit, and one that attracted the attention of every visitor to the Garden, was the Kinsman Block System Company's protective train apparatus. There was laid upon the floor of the Garden a short track equipped with guard rails and switch, and a full-sized brake equipment and semaphore. There were actual demonstrations given of the instantaneous working of this protective apparatus, the precision of movement eliciting favorable comment on all sides.

The Kinsman Electric and Railway Supply Company, New York city, exhibited the "phonoscopic" or electric detector, a device for the use of station managers for keeping a watch on the condition and operation of the circuits, dynamos and station apparatus. The Kinsman company also exhibited the Kinsman auxiliary car lighting system. This system comprises a means for keeping a car illuminated even though the main current may be shut off. The automatic switch-over cuts in a series of batteries the instant that the line current fails. When the line current comes on, the automatic switch cuts out the batteries.

The Wireless Electric Company, Philadelphia, Pa., exhibited a working model of the Pullen surface-contact system of electrical propulsion. There was a miniature trestle and standard railway car running back and forth showing the operation of the surface-contact railway, and a full-sized electric mining locomotive utilizing the same system. This company also exhibited a new type of arc lamp.

The Brunswick Refrigerating Company, New Brunswick, N. J., exhibited the advantages of a household refrigerating cabinet.

The Prometheus Electric Company, New York city, exhibited a fine line of electrical cooking and heating utensils.

The Natural Food Company, Niagara Falls, N. Y., exhibited the methods by

which this food product is prepared for distribution. The material is prepared entirely by means of electrical apparatus and cooked in electrical ovens.

The Chicago Pneumatic Tool Company, Chicago, Ill., exhibited its "Little Giant" storage batteries for automobile and power purposes, and a line of storage batteries for gas engine ignition. The exhibit of electrical drills of various sizes was very interesting and attracted a great deal of attention.

The Stow Manufacturing Company, Binghamton, N. Y., presented an example of electric driving for printing apparatus.

The Enos Company, New York city, made a handsome exhibit of electrical and gas fixtures. A particularly attractive piece of work was the crystal chandelier hung in the centre of the booth. This was illuminated with cut-glass bulbs and miniature candle lamps.

The American Electric Novelty and Manufacturing Company, New York city, had a very large booth and exhibited a great number of novelties, many of which were immediately secured by the visitors.

The George L. Mason Company, New York city, exhibited the Mason jeweled signs.

The Niagara Tachometer and Instrument Company, Buffalo, N. Y., exhibited a complete line of spring tachometers, bifluid tachometers and tachographs.

The Clark Electric and Manufacturing Company, New York city, exhibited a line of high-tension insulators and insulating material.

The Peerless Electric Company and the Magnet Wire Company, New York city, showed an interesting line of electrical specialties.

The National Battery Company, Buffalo, N. Y., showed a complete line of batteries and accessories.

The International Text Book Company, Scranton, Pa., displayed a series of the correspondence courses, and its representatives exhibited the methods by which this company disseminated its information.

The Gray National Telautograph Company, New York city, had on exhibition a number of "telautographs." This ingenious writing telegraph was the centre of a great deal of interest, and a number of the visitors took away with them written messages as souvenirs.

The General Storage Battery Company exhibited the "Bijur" high-duty storage battery.

The Electro-Radiation Company, Boston, Mass., exhibited X-ray and electrotherapeutic apparatus.

The Simplex Electric Heating Company, Cambridgeport, Mass., through its New York agent, Roger Williams, exhibited a very complete line of electrical cooking and heating apparatus.

Charles A. Thompson Company, representing the St. Marys Incandescent Lamp Company and the Sun Porcelain Company, Trenton, N. J., made an elaborate display of electrical specialties and incandescent lamps.

The National Meter Company, New York city, exhibited a direct-connected, fifty-horse-power, multiple-cylinder, Nash gas engine driving a thirty-kilowatt C & C generator. The current was used to light up a large number of signs.

The Magneta Company, New York city, exhibited a complete line of Magneta electric clocks.

G. M. Gest, 277 Broadway, New York city, showed a large number of photographs illustrating the modern developments of conduit construction.

Dossert & Company, New York city, exhibited the Dossert connectors.

The Safety Electric Elevator Company, New York city, showed the features of its safety electric elevator.

The American Telegraphone Company, New York city, made an exhibit of its reproducing instruments.

Holcombe & Company, New York city, presented an exhibit of electrical supplies and novelties.

Waterbury & Company, New York city, showed a fine line of switchboards, wires and cables.

The Electro-Dynamic Company, Bayonne, N. J., exhibited an "Inter-Pole" motor driving another motor as a generator. The current was used in illuminating the booth. Demonstrations were given of the speed changes and reversals with sparkless commutation.

Caldwell & Ousterhaudt, New York city, showed a line of electrical supplies. This company represented the Century Electric Company, St. Louis, Mo.; the American Vibrator Company, St. Louis, Mo.; the Crescent Electrical Manufacturing Company, Rochester, N. Y., and the Kirkpatrick Manufacturing Company, Philadelphia, Pa.

The Standard Vitrified Conduit Company, New York city, made an extensive exhibit of vitrified conduit and third-rail insulators.

The Eastern Carbon Works, Jersey City, N. J., exhibited carbon products and dry batteries. These batteries are made up in various forms for telephones, electric bells, annunciators, gas lighting and similar work. Carbon, cylinders, porous cups, plates, discs, boxes, rods, smelting electrodes and brushes were shown. There was also shown the pocket flash lamp manufactured by this company.

The National Carbon Company, Cleveland, Ohio, exhibited the Columbia dry batteries and carbon products. A special feature of the exhibit was a recent improvement in the form of an expansion pig-tail brush attachment, which has been described at length in these columns.

Through the courtesy of the department of street cleaning of the city of New York, there was exhibited a complete working model of the light refuse crematory. This incinerator has been built near one of the piers used to load sea-dumping scows of the street cleaning department. The primary object of the incinerator is to save the unnecessary expense of carrying out to sea bulky material such as waste paper, excelsior, packing-boxes, rags and other kinds of dry refuse. There was also a model of the Williamsburg bridge.

The "Navalite" Conduit Company, New York, N. Y., had a bootblack dressed as a sailor, who gave as many visitors as desired a free shine.

New York Electrical Society.

The 255th meeting of the New York Electrical Society will be held at the American Institute, 19 West Forty-fourth street, on Wednesday, December 20, at 8 P. M. Mr. J. M. Waldron, signal engineer of the Interborough Rapid Transit Company, will deliver a lecture on "The Signal System of the New York Subway." Mr. Waldron will illustrate his lecture by lantern slides, and he will discuss: Why it was necessary to install a block-signaling system; the selection of a system, the power distribution, the alternating-current track circuit; the alternating-current relay, the mechanism of the signal, the automatic train stop, the air supply and distribution, the interlocking plants, the practical operation of the system.

Murgas Wireless Telegraph System Tested Out.

The wireless telegraph system invented by Father Joseph Murgas, of Wilkesbarre, Pa., which was described at length in the ELECTRICAL REVIEW of December 2, was given a thorough test between Wilkesbarre and Scranton, Pa., on November 24. Colonel Joseph F. Stokes, Philadelphia, Pa., president of the Universal Aether Telegraph Company, which is to extend the Murgas system, and John Wills, treasurer, together with the secretary, Mr. Charles McGee, are highly pleased with the tests. A number of clergymen took part in the transmission of the messages, the entire apparatus, it is announced, working with the greatest facility.

Reviews of Current Engineering and Scientific Literature.

The Spherical Photometer in Theory and Practice.

After first studying the necessity for determinations of the spherical candle-power of an illuminant, Dr. L. Bloch takes up the theory and application of the Ulbricht spherical photometer. This photometer is based upon the theory that if an illuminant be placed within a spherical chamber having a diffusing surface, that the illumination at any particular point in the sphere can be computed. This is done, first assuming the illuminant to be at the centre of the sphere, and then placed eccentrically. Cases of symmetrical and unsymmetrical distribution are considered, and formulæ derived for them. The author then describes the construction of the spherical photometer as adapted to practical use. It consists of two half-spheres of sheet zinc two millimetres thick, with handles for handling, and rims for attaching them together. An opening at the top serves for the introduction of the light, and one at the bottom for giving access to the lamp. Three smaller openings with suitable covers are provided. These are arranged in a vertical plane, and spaced about forty-five degrees apart. Through the upper of these a white cardboard disc is introduced on a rod, and this is observed through one of the other openings. The intensity of illumination of this disc is a measure of the spherical candle-power of the lamp. For determining the illumination a special Brodhun photometer is employed. This has an opening, through which the light radiated from the cardboard disc is allowed to fall upon a screen, and then, by means of prisms, is reflected to the photometer field. The comparison light is a small incandescent lamp supplied from a storage battery, which, by means of a series of Nichol prisms, also throws its light upon the field. These two prisms are mounted so that they may be revolved by a small electric motor. By means of a screen the amount of light passed through to the photometer field can be varied. In this way a balance is obtained, and the illumination of the field read off.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), November* 16.

"Permutators" for the Societe Anonyme Egyptienne D'Electricite.

At the International Exposition of Liege, the Société Anonyme Egyptienne d'Électricité exhibited three "permutators" for converting alternating current of 3,000 volts to a direct current of 200 volts. These "permutators" were constructed according to the Rougé and Fajet system, were rated at 150 kilowatts each, and were exhibited for the first time here. The "permutator" differs from a rotary converter in that the parts of the machine are stationary, the relative motion of conductors and field being secured by means of a three-phase rotating field. The direct current is taken off by rotating brushes. In construction the machines consist of circular iron stampings wound so as to set up a rotating field. These conductors are connected to suitable commutator bars, upon which the brushes are pressed. The higher-potential current is transformed down by means of three sixty-kilowatt transformers, and is then introduced into the "permutator." By means of a neutral wire connected to the central point of the transformers a three-wire system is obtained. By connecting two of these in series a five-wire distribution is obtained. This allows one of the three units to be held in reserve. The "permutators" are of the vertical type, and about 1.7 metres high. The maximum diameter is a little less than one metre, and they are constructed with eight poles. The speed of the brushes is 750 revolutions per minute, corresponding to a frequency of fifty cycles. The efficiency under full load is ninety-three per cent, and the power-factor ninety-seven. But three seconds are required to connect these machines to the supply circuit. When they are in use the potential is regulated by means of taps connected to the reducing transformers. The advantages claimed for the "permutator" over a rotary converter are that it is impossible to throw the machine out of step, since there is no heavy moving part. There is no difficulty in connecting the machine to the circuit. To do this it is only necessary to throw on the alternating-current supply, and the brush-motor at once starts up as an induction motor and comes up nearly to synchronous speed. Then, by closing a switch, the field of this induction motor is supplied from the direct-current side, converting it into a synchronous motor. The polarity of the machine is then indefinite, since there is nothing to determine the way in which the auxiliary motor is thrown into step. However, if wrong, by opening the circuit of this motor, and closing it again, the motor may be caused to fall back one pole, thus reversing the polarity of the direct-current brushes. It is said that an experienced attendant has no difficulty whatever in doing this, and in nine times out of ten accomplishes the change by one opening of the switch only.—*Translated and abstracted from L'Industrie Électrique (Paris), November* 25.

Utilization of Atmospheric Electricity.

From times of old, man has decided to utilize nature's supply of electricity as evidenced in lightning; yet so far nothing has been done in this direction. In order that anything might be accomplished it is first necessary that the existing conditions should be investigated in order to determine what possibility, if any, there may be of such development. Explorations of the atmosphere have proved that large differences of potential exist in it at points not widely separated. It has been found that a difference of potential of 100 volts per metre has been measured, and even values as high as 300 volts. Accepting the former figure one might then, under suitable conditions, by means of a conductor 100 metres long, have its ends placed at two points where the difference of potential is 10,000 volts. Under favorable conditions this difference of potential might reach 30,000 volts. With a conductor 200 metres long, these values would be doubled. It seems to M. A. Breydel that there should be some means of utilizing these enormous forces. There should be some way of collecting the electricity at the higher potential, and, by the use of proper transformers, converting this into a form suitable for practical application. It has been found, further, that these enormous differences of potential are, in general, observed when the sky is clear, and there is little or no wind. This suggests that attempts to utilize atmospheric electricity should go hand in hand with means for utilizing the wind, since when one source of power failed the other would most likely be available. It is suggested that a possible method of collecting this energy be to send up balloons surrounded with a network of conductors. The author quotes some experiences of the engineers on certain of the Swiss mountainous transmission lines, who observed that the lightning arresters were apt to discharge in the evening when there seemed to be no reason for the higher potentials existing. At the time it was suggested that there was some thermal effect taking place because of the

sudden fall in temperature with nightfall at the power-house, but this evidently could not have been the case, and the effect must have been due to atmospheric discharges. It is thought that by means of a transmission line carried up a mountain so as to give a difference in altitude of about 800 metres between the upper and the lower ends, that this should make available a potential of from ten to thirty thousand volts. No suggestion is given as to the method by which this high tension is to be converted to pressures suitable for commercial use.—*Translated and abstracted from L'Électricien (Paris), November 25.*

Pipe-Line Power in Niagara Gorge.

Mr. Alton D. Adams considers here the possibility of utilizing the fall of water in the Niagara gorge by means of pipe-lines carried along the cliff. The fall of water from a point of about 500 feet upstream from the cantilever railway bridge to the whirlpool, a distance of about 6,000 feet, is fifty-one feet. If the pipe-line were continued beyond this point for a further distance of about 7,000 feet, making the total length 13,000 feet, a water head of fully eighty feet would be obtained. A pipe-line laid on the Canadian bank of the river from the same point above the bridge would also be 6,000 feet long to the whirlpool, and have the same head; but if carried low enough down to the gorge to make a head of eighty feet available, would be about 17,000 feet in length. The normal discharge of the Niagara river is 220,000 cubic feet of water per second, which, with an available head of eighty feet, would develop 2,000,000 gross horse-power, but the entire discharge of the river could not be utilized without constructing a dam across the bed of the river near the bridge. An eighteen-foot pipe might, however, be carried along the bank at the foot of the cliff, and to fill this with water would not require the construction of a dam. If the flow through this pipe were allowed to take place at a speed as great as that contemplated by the Ontario Power Company there would be a loss of three feet in head for every 1,000 feet of pipe, which, with the available head of only fifty-one or even eighty feet, would be too great. Reducing the flow to nine feet per second reduces the loss of head to one foot per thousand feet of pipe and this, with an efficiency of seventy-two per cent for the turbine wheels at full load, will give a total efficiency of about sixty per cent in developing the eighty-foot head. Under these conditions an eighteen-foot pipe, laid as suggested so as to give an eighty-foot head, would develop a total of 20,600 horse-power, and supply substantially 12,000 electrical horse-power. A similar plant constructed on the Canadian side would develop somewhat less, due to the increased length of pipe, and the available electric power would be about 8,800 horse-power. Assuming a cost of three cents per pound for the pipe, the investment in the eighteen-foot pipe-line 13,000 feet long would be $468,000. For a pipe-line 6,000 feet long it would be $216,000. The investment per available horse-power of output would therefore be $39 for the longer line, and $24.54 for the shorter one. It is thought that these figures are certainly much below what the value of the power would warrant. In comparison with this pipe construction there is considered a tunnel through the cliff, similar to those constructed above the falls. It is shown that this tunnel would cost thirty-six per cent more for the same capacity and efficiency than the steel pipe, in spite of the fact that the tunnel, by making a direct line, would be somewhat shorter.—*Abstracted from Cassier's Magazine (New York), December.*

The Beginning of a Cost Accounting System.

In a recent issue of *American Industries*, Mr. Henry Abbott, president of the Calculagraph Company, New York city, contributed an article entitled "The Beginning of a Cost Accounting System." Mr. Abbott contends that it is of the utmost importance to the success of any system of cost accounting that original entries or records shall be truthful, and that the usefulness or worthlessness of the figures resulting in working out a system of accounts depends wholly upon whether or not the beginning has been made with accurate records.

Mr. Abbott cites several instances of the lack of facility for accurate cost keeping, and concludes his article, in part, as follows:

During the past ten years the writer's business has brought him into more or less intimate association with the operation and management of the telephone business, and he has on many occasions witnessed and studied the results of tests of the efficiency of telephone operators in computing and recording the time consumed in telephone toll messages. Such tests have been made in practically all of the larger cities and towns of the United States, and have covered the work of hundreds of different operators under a great variety of conditions. Stop-watches were generally employed in making the tests, and the inspectors using them had nothing to do but watch the electric signals showing the beginning and the end of a conversation and press the button of the stop-watch.

In every such test within my knowledge, where the telephone operators employed a visible clock dial to note the time and a pencil to write it down, the percentage of errors was largely in excess of a majority of the total number of records.

Results were not much improved when the time of day was printed with a "time stamp" at the beginning and again at the end of the conversation, as the clerks employed to subtract the one record from the other made nearly as many errors as did the operators who made a "bluff" at doing the "sum" mentally after looking at the clock.

So exhaustive have been such tests, and so conclusive their results, that telephone engineers now universally concede that it is a physical impossibility for a telephone operator accurately to time messages with a visible clock dial and pencil.

Such practice has also been abandoned and the obvious has been substituted. A machine which does not forget, which can not guess, and which makes no clerical errors, has been employed to do the work of timing. This machine not only prints the time of day, but subtracts the commencing time from the stopping time and records the difference—the elapsed time. The machine is now used and has been universally used for several years in all the larger telephone exchanges throughout the United States, Canada, Europe, Asia, Africa and South America.

Factory managers might do well to take a lesson from the telephone engineers and investigate what happens in timing labor in their employ. It is my opinion that they would reach the same conclusion; that it would be found equally impossible or impracticable for mechanics to make, with a pencil, accurate and truthful records of their working time. They are equally human, and are probably, as a rule, not above the average of the telephone operator in mental arithmetic.

The same remedy is available to the manufacturer. The same machines are made suited to his purpose. And when he has taken time-keeping out of the hands of his mechanics and given it to a machine, which by the simple operation of levers is capable of computing and recording the actual working time, as well as the time of day, he will have made a proper beginning and will have laid the foundation for a reliable system of factory cost accounting.

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

Mr. B. Irwin Dasent, who is connected with the advertising department of the Portland General Electric Company, Portland, Ore., contributed a very interesting article to the November issue of *Pacific Coast Advertising.* As this company is meeting with a very gratifying success in its methods of publicity, the following abstracts will be of interest to all concerned in this department:

"The advertising of the electric light and power company is properly more in the nature of a bid for investigation and incitement to curiosity—a spur to the propounding of questions. It requires a personal interview to secure a contract; hence in the advertisements of the Portland General Electric Company, we do not attempt to tell the whole story. Our end is attained if we have succeeded in arousing the interest of readers of our advertisements to the degree that eventually leads them to ask questions, which it will be the business of our representative to answer.

"Advertising with the direct purpose of selling electricity must primarily be 'class advertising,' for those to whom electricity may be sold are in number comparatively limited, and therefore general publicity, which, in the case of the cereal, or other popular commodity, would manifestly be the advertiser's procedure, would in this instance be entirely too expensive, and would, in fact, entail a waste of ammunition; reminding one of the hunter who, from lack of skill, perhaps, resorts to a Gatling gun to bring down a couple of birds that could just as easily have been picked off with two shots of a rifle in the hands of an experienced marksman.

"The electric light and power company does not sell current in popular packages by mail, hence direct returns from advertising are not expected. Our advertising is, therefore, primarily educational, and aimed at those who are, perhaps, unaware that electricity is the *Summum Bonum* which is required to transform an uncomfortable city home into an earthly paradise. This class of readers, however, is not so important as that important clientele of every electric light company—its customers, who must be educated in the use of this potent factor. An important and interesting feature of our campaign of education in Portland is *The Bulletin,* a monthly illustrated journal published by the company, and sent to a selected list of customers, actual and prospective. The advertising qualities of *The Bulletin* must be aggressive in tone, positive in quality, and educational in nature, without being pedantic. The public at large is still greatly ignorant of the possibilities and advantages of electricity, and it must be educated.

"*The Bulletin* or house publication, has become in these days an almost necessary adjunct to newspaper publicity. In the newspaper your advertisement is as one voice in a crowd. If your advertisement possesses the necessary staying qualities, it will survive the ordeal and speak to your reader in tones above the babel of the Sunday newspaper. There is, however, always the counter attraction of the multitude of other voices, all clamoring the virtues of their respective wares. With the bulletin, or house organ, you take Mr. Business Man into your confidence, chat familiarly with him, enliven his interest with pictures, and plant all sorts of fertile seeds in his brain. There is no conflicting influence. His attention, for the time being, is yours to a marked degree—'if'—your *Bulletin* possesses the right elements.

"Keep in sympathetic touch with your customers. Show them that it is to your mutual interests to establish and exchange friendly relations. Impress on their minds that you desire their friendship, and make the appeal as personal as good taste and judgment will permit. Try to meet the needs and conditions of the various classes of your customers. To fulfil adequately its mission, *The Bulletin* should contain material of specific interest to the merchant who needs electric light in his store and electric signs over his doors, to the manufacturer who is striving to solve the problem of cheap power, to the architect who may be one of your chiefest allies, the engineer, the contractor, the family man who pays the bills, and the good housewife whose divine right it is to create the bills."

Mr. John F. Gilchrist, contract agent of the Chicago Edison Company, has hit upon a very ingenious plan for keeping in touch with the architects and designers of new building construction in the territory supplied by the company. To each of these builders, as soon as the construction is determined upon, a letter is sent. The statement is put forth that the builder will undoubtedly wire the building for electric light and power, and the liberty is taken of enclosing a copy of specifications, which, if complete, will result in the building being wired in such a thorough manner as to obviate any unnecessary expense on the part of the builder when it becomes necessary to turn on the current. The suggestion is also made that the company will be pleased to have a representative call and advise with regard to the adaptations of electric light and power arrangements. Along with the letter is sent a copy of the specifications, these being so drawn up that a very good idea is presented of the proper methods of installation and the wiring made to conform with standard electrical rules.

The Newcastle Electric Supply Company, Newcastle, England, has often taken the initiative in methods of engineering organization. The company has devoted its attention very seriously to the question of advertising, and has recently made use of what would be considered in this country a startling innovation, in stimulating the demand for current. This was in the equipping of half a dozen "sandwich men" with large signs calling attention to the reduction in the price of electricity by the Newcastle company. The success with which this movement has been met has not yet been announced.

Electricity in the Modern Drama.

The presentation, under the direction of Mr. William A. Brady, at the Garden Theatre in New York city last week, of Shakespeare's tragedy, "King Lear," afforded an opportunity for a most remarkable display of electrical effects in the storm scene in the second act. The artificial lightning and the cloud effect were carried out in a most realistic manner, and Mr. Brady has been receiving congratulations on all sides for this refined spectacular arrangement.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Allis-Chalmers Steam Turbine.

The recent starting up of a steam turbine at the Washington street power-house of the Utica Gas and Electric Company Utica, N. Y., calls attention to the fact that this is the first turbine to be put into operation by the Allis-Chalmers Company, which has recently entered the steam turbine field. The turbine outfit installed at Utica is shown by the accompanying Fig. 1.

This turbine is rated at 1,500 kilowatts normal load, and runs at a speed of 1,800 revolutions per minute. It is direct-coupled to an Allis-Chalmers, two-phase, sixty-cycle, revolving field alternator, operating at 2,500 volts. The unit has a continuous overload capacity of twenty-five per cent, with a three-hour, fifty per cent overload capacity, without exceeding a safe generator temperature, and capable of a 100 per cent safe momentary overload. Artificial ventilation by means of an electrically driven fan blower will, however, enable the unit to be run safely beyond its rated overload capacity.

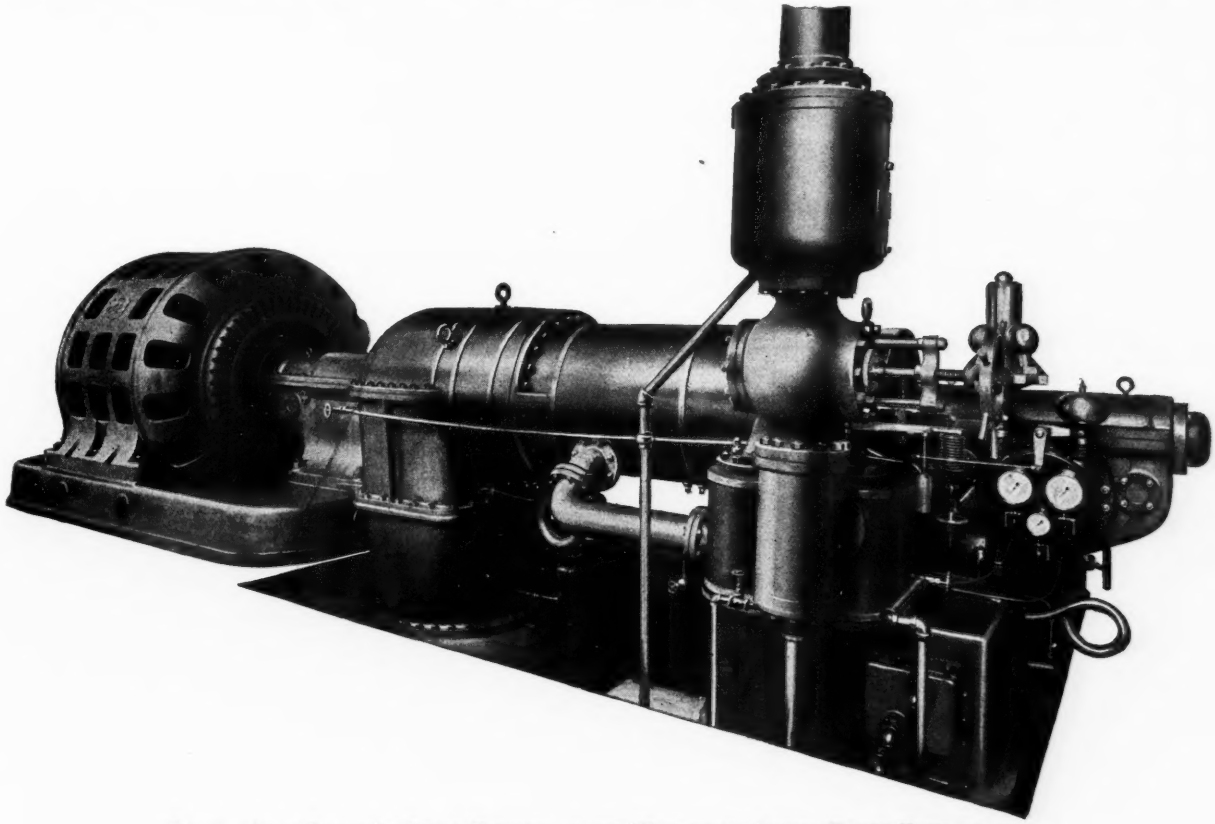


FIG. 1.—ALLIS-CHALMERS STEAM TURBINE AT THE WASHINGTON STREET POWER-HOUSE OF THE UTICA GAS AND ELECTRIC COMPANY, UTICA, N. Y.

The turbine follows the well-known Parsons type, which has proven itself eminently successful in numerous installations both here and abroad. The Allis-Chalmers construction, however, embodies a number of features which are new in this country, and which are claimed by the builders to be distinct improvements.

The chief distinguishing feature of this construction is the blading, which, while it is of the Parsons reaction type as regards the principle of operation, differs in mechanical construction in a number of essential details.

The roots of the blades are formed in dovetail shape by special machinery, and are inserted in slots cut in foundation or base rings; these slots being formed by special machine tools in such a way as to exactly conform to the shapes of the blade roots. The foundation rings themselves are of dovetail shape in cross-section and are inserted in dovetailed grooves cut in the turbine cylinder and spindle respectively, in which they are firmly held by key-pieces, much in the same way that the well-known "Lewis bolt" is fastened. In order to further ensure the integrity of the construction, the key-pieces or rings, after being driven into place, are upset into undercut grooves.

Another noticeable feature of the blading is the method of reenforcing and protecting the tips of the blades. This point in steam turbine design is one upon which much thought has been expended by various inventors, and the Allis-Chalmers Company claims that the construction employed by it successfully solves all difficulties. In forming the blades a shouldered projection is left at the tip. This is inserted in a slot punched in a shroud-ring; the slots being punched by special machinery in such a way as to produce accurate spacing and at the same time form the slots so that they will give the proper angles to the blades independent of the slots in the base-ring. After the blade tips are inserted in the slots in the shroud-rings they are riveted over by specially arranged pneumatic machinery.

The shroud-rings are made in channel shape, with outwardly projecting flanges, which, after assembly in the turbine, are turned and bored to give the necessary

working clearance. The flanges of the channels are made so thin that, although amply sufficient for stiffness, the shroud-ring does not have the disadvantage of

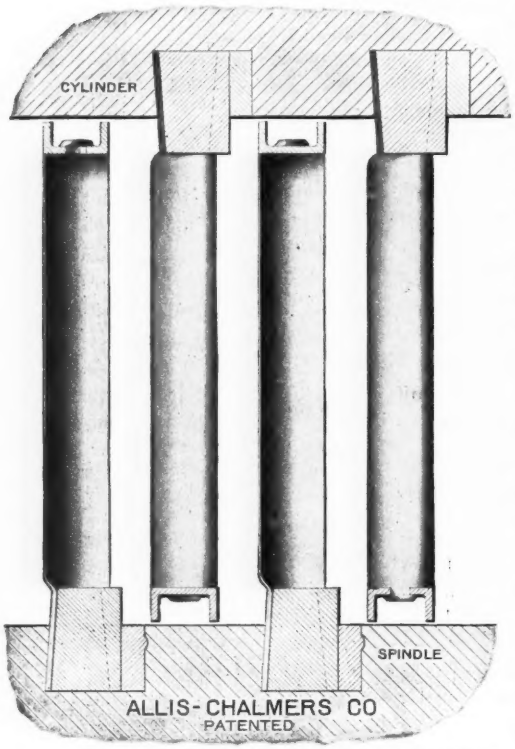


FIG. 2.—BLADE CONSTRUCTION, ALLIS-CHALMERS STEAM TURBINE.

a solid shroud which acquires a dangerous temperature by friction in case of an accidental contact of the rotating and stationary parts. It is claimed for this construction that the blades are stiffened against the effect of vibration in a much more substantial manner than by any other means thus far employed, while the use of a protecting shroud-ring enables the working clearance to be made smaller than in the case of naked blade tips, without danger in case of accidental contact, thus reducing the leakage loss to a minimum; the leakage past the blade tips being the principal source of loss in the steam turbine. As to the safety from damage in case of accidental contact, it is claimed that this has been proven by experiment with actual blading by throwing the bearings out of centre so as to produce contact, without detrimental results. An incidental advantage claimed for this construction is that if by chance a blade should prove defective, it is so held in place by the shroud-ring that it can not possibly work loose and produce damage.

By the method of construction described, the entire blading is produced by machinery, thus eliminating the personal equation which enters into blading done by hand-work, which depends upon the skill of the individual workmen. Besides ensuring that every blade is securely fastened, all blades are necessarily set at exactly the designed angle and pitch; the openings between blades, upon which in great part the economical performance depends, being absolutely uniform. The blading is made up in half rings in the blading shop, and is carefully inspected before being inserted in the turbine.

Fig. 2, which was photographed from a drawing, shows the general scheme of the blading, illustrating the method of fastening the blades as well as the channel-shaped shroud-ring. Fig. 3 shows two half rings of blades ready for assembly in a turbine; these half rings being respectively the smallest and largest ones used in a turbine of the size installed at Utica. Fig. 4 is from a photograph of blading, showing the substantiability of the construction as well as the uniformity of the work. Fig. 5 shows a turbine spindle of the same size as that of the Utica turbine, this photograph having been taken in the West Allis shops of the Allis-Chalmers Company.

Another special feature of this turbine will be noticed by referring to Fig. 5, viz., the absence of the usual low-pressure "balance piston"; the photograph showing only two balance pistons instead of the three pistons formerly used in this type of turbine, where it is said to have been found difficult to produce a balance piston of the size required for balancing the low-pressure stage of the turbine and at the same time make it sufficiently rigid to run with the necessary small working clearance. In the Allis-Chalmers construction there is, however, a third balance piston, but instead of being at the high-pressure end of the turbine, as formerly arranged, it is at the low-pressure end, and as it is smaller than the large end of the spindle it is hidden from sight in the photograph. By making this piston in such a way that its circular area is equal to the annular area of the pistons used in the older construction, the low-pressure balance piston is made much smaller. Instead of reducing the leakage past this piston by means of "dummy packing," as in the high-pressure and in-

FIG. 3.—LARGEST AND SMALLEST BLADES, ALLIS-CHALMERS STEAM TURBINE.

termediate pistons, and as used in the low-pressure pistons of the older construction, a labyrinth packing of radial baffling

FIG. 4.—ARRANGEMENT OF BLADING, ALLIS-CHALMERS STEAM TURBINE.

type has been adopted, thus eliminating small axial clearance in this turbine. A considerable advantage is claimed for this construction in permitting of the use of smaller working clearances in the high-pressure and intermediate balance pistons.

There are a number of other points of improvement claimed for the Allis-Chalmers construction which will not permit of description within the space of the present article. These include details of spindle construction, governing mechanism, lubrication and other minor features.

The alternating-current generator of the Utica outfit also is deserving of more description than the present article will allow. Perhaps the most noticeable feature of this generator is the substantial design of the revolving field, providing great strength and at the same time giving the thorough ventilation which is essential. Particular attention has been paid to the insulation, as may be inferred from the fact that the armature (Fig. 6) was subjected to an alternating-current insulation test of 10,000 volts for the period of fifteen minutes. This generator was built at the Bullock works of the Allis-Chalmers Company at Cincinnati, where the generators for all of its turbine outfits are being built.

FIG. 5.—TURBINE SPINDLE, ALLIS-CHALMERS STEAM TURBINE.

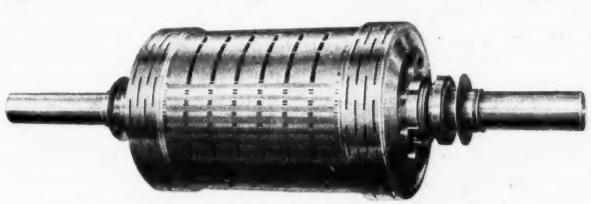


FIG. 6.—ARMATURE, ALLIS-CHALMERS TURBO-GENERATOR.

The Allis-Chalmers Company, in entering the steam turbine field, effected an alliance with the Turbine Advisory Syndicate, of England, thereby securing the cooperation of the firms therein interested, including Messrs. Willans & Robinson, the famous high-speed engine builders, of Rugby; Yarrow & Company, the well-known torpedo-boat builders, of the Isle of Dogs, London, and the Neptune Shipbuilding Works, Walker-on-Tyne. The Utica turbine, in fact, was built for the Allis-Chalmers Company by Messrs. Willans & Robinson, to whom a number of turbine contracts were sublet by the Allis-Chalmers Company before the latter had perfected the installation of its special machinery for turbine manufacture. An agreement has more recently been effected with the Hon. Charles A. Parsons, C. B., for interchange of data, thereby giving to the Allis-Chalmers Company the benefit of the vast experience of Mr. Parsons, the original inventor of this type of turbine, and to whose engineering ability and indomitable energy the evolution and present state of perfection of the successful steam turbine are principally due. The Allis-Chalmers Company has also secured rights under Mr. Parsons's patents for marine turbines and turbo-compressors and blowers, for which there is a growing demand.

At present the Allis-Chalmers Company

is building its steam turbines in its engine works at West Allis. The growth of the business, however, has led to a large extension of the works, amounting to a practical doubling of the present plant. A considerable part of the extension will be devoted to the manufacture of steam turbines and the accompanying electric generators; one of the three new manufacturing buildings being given up to the exclusive manufacture of the turbines themselves. The first steam turbine of the Allis-Chalmers Company's own make, of 5,500 kilowatts capacity, has recently been shipped, and others are following as fast as the present crowded condition of the shops will permit.

Westinghouse Pipe-Thawing Outfits.

The superiority of the electric current as a thermal agent is generally recognized and its convenience and effectiveness have led to its utilization in the thawing of water pipes, gas mains, telephone conduits, and the like. It is necessary that the apparatus for such purposes shall have a range in capacity adequate to cover all ordinary requirements; shall be easy to connect and moderate in price; shall be portable and light in weight so as to be easily handled; shall be able to withstand rough usage, and shall ensure protection from injury to the operator.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has placed on the market two outfits, one for heavy service, comprising a specially designed choke coil used in connection with the primaries of a standard transformer, and one for lighter service, consisting of a transformer adapted for suitable secondary voltage adjustments mounted in cast-iron top and bottom frames. The heavy-duty outfit consists of the choke coil connected in series with the primary of a standard 2,200-volt, sixty-cycle transformer of from fifteen to twenty-five-kilowatt capacity. The choke coil is compactly built and enclosed in a cast-iron case which occupies a floor space of sixteen by sixteen inches. Five plug receptacles mounted in the upper portion of the case provide a simple means of varying the primary voltage. The various taps give approximately fifty, sixty, seventy-five, eighty-seven and ninety-five per cent of the full-line voltage. By changing the position of the plugs, any one of these combinations may be used.

The smaller outfit is intended for lighter service, such as thawing house piping. It is compactly built and enclosed in a case with cast-iron top and bottom, the transformer laminations themselves being exposed to the air, thus providing excellent conditions for cooling. Handles are provided on the top casting which will enable one man to carry the transformer, as its weight complete is approximately 100 pounds. It is intended for use on 2,200-volt, sixty-cycle circuits, and has a variation in secondary voltage from fifty-five to thirty-five and will maintain a current of 100 amperes for one-half hour without undue heating. No oil is used with this transformer, as the insulation is specially prepared to withstand severe conditions.

In operation the transformer should be

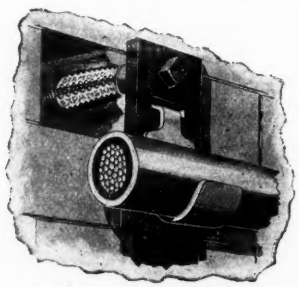
WESTINGHOUSE PIPE-THAWING TRANSFORMER.

placed as near the pipes to be thawed as possible. For dwellings one low-tension lead may be connected to a faucet and the other to a hydrant so as to enclose the frozen section. For thawing street mains two hydrants may be conveniently used. On account of the different conditions met with it is impossible to prescribe the exact voltage or current necessary to do any particular thawing. In general, the voltage necessary to force the same amount of current over pipes of the same diameter will vary with the length of pipe. Large pipes require less voltage to force the same current through a given length, but require more current to thaw them.

For pipes up to five inches in diameter approximately 500 amperes is usually sufficient, while twelve-inch mains may require 1,000 amperes. As a rule a small current for a long period of time will do the work that a large current will do in a shorter time, and the thawing will be done with less chance of injury to the piping system.

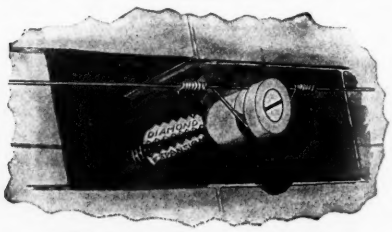
The Diamond Expansion Bolt and Shield.

The accompanying illustration shows the application of the Diamond expansion bolt and shield with a cable grip and cleat. This shield is made to fit regular stock lag-screws manufactured by different



EXPANSION BOLT AND CABLE CLAMP.

manufacturers. The method of application of the Diamond expansion-shield is readily seen from the illustration. A hole large enough to accommodate the serrated

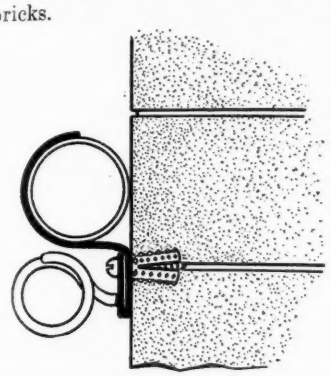


EXPANSION BOLT AND CLEAT.

shield is made in the wall, and then the screw is inserted through the piece to be supported and threaded into the interior column of the shield. As the screw is threaded down into the interior column of the shield, the serrated edges are backed into the material of the structure, taking a firm hold, and at the same time making a contact that may be easily released if necessary.

Another innovation which the manufacturer of this device—the Diamond Expansion Bolt Company, 9-15 Murray street, New York city—has placed on the market is a cable clamp designated as the

"Long-Saut" cable clamp. This makes a standard fastening for stone and wood alike. The expansion bolt and cable clamp eliminates the driving of a wooden plug and spike dog, and combines a cable grip and bridle ring in one piece. It also eliminates the drilling of an extra hole and avoids spoiling the face of the stone or bricks.



EXPANSION BOLT, CABLE CLAMP AND BRIDLE RING.

Another interesting article made by the same company is the "Omega" toggle. This is for attaching fixtures to hollow brick, tile, thin marble, plaster, fireproofing, etc. Instead of a nut, two springs are riveted on each end of the head and meet in the centre over the hole the screw passes through. These springs are punched out in a half-circle, and engage the thread and body of the screw, clamping it tightly with an upward strain. The screw can be pushed in or easily screwed in or out, but can not be pulled out. Screws of any length may be used. A string is furnished, attached to the toggle head, to hold the head in the wall while the screw is being adjusted.

The Efficiency of a Hand-Generator.

With the development of telephone service in connection with rural districts, the stages in the evolution of the magneto hand-generator show in a measure the degree of perfection which has been attained up to the present time in the operation of rural lines. If it were possible to have only one telephone on a line the cost in most cases for telephone service to individual parties in sparsely settled districts would be prohibitive, and on this account party-lines have come into very general use, mainly on account of the small cost for such telephone service.

The average number of calls per day of each party so situated is very small, and for that reason it is possible to give fairly good service to each party on the line, even though the total number of parties may be as high as twenty or twenty-five. The value of a telephone to a farmer is very great, for with the telephone at his command he can be in touch with the many changes in the market values of his different products, and will be less liable to enter into transactions which would be unprofitable to him on account of being able to get information quickly, and it is evident he could not do so were it not for the telephone.

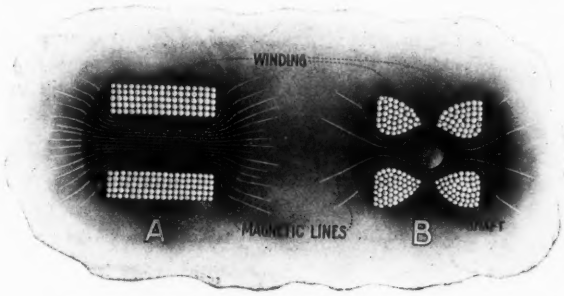


FIG. 1.—CONSTRUCTION OF MAGNETO GENERATOR ARMATURE.

This class of telephone business is very profitable, and a small exchange, with from ten to fifty lines, will accommodate a large number of farmers at a small cost for maintenance. In connection with this development of rural party-line service, several difficulties are met with. In only exceptional cases is it possible, or even feasible, to have a power-ringing system, and in consequence it is necessary to furnish the switchboards with hand-generators which will be sufficiently powerful to ring the bells over these heavily loaded lines. It goes without saying that such party-lines have their ringers bridged, these ringers being usually wound to resistances averaging about 1,600 ohms.

Aside from the actual difficulty in ringing a large number of bells in multiple, there is another matter peculiar to rural lines, which has to be taken into consideration. This trouble is due to the proverbial curiosity of the subscribers on these rural lines who are continually listening in to find out the business of the other people in that locality. This trouble has been largely overcome by inserting a condenser of from one to two microfarads capacity in series with each ringer on the line. However, this would be of no use unless a generator were furnished of sufficient current output to ring the total number of bells.

Various hand-generators have been devised which will furnish the required amount of current, but there has always been a difficulty in constructing the armature of the generator in such a manner as to give sufficient space for a large number of turns of wire. Fig. 1, "B" shows a cross-section of one type of hand-generator armature. The shaft makes it impossible to wind very much wire on to the armature, and as the current-output depends, to a great extent, on the size of the wire used, it is apparent that the size of the wire could not be increased materially without greatly cutting down the number of turns which are necessary.

FIG. 2.—NEW KELLOGG MAGNETO GENERATOR.

FIG. 3.—GENERAL CONSTRUCTION OF NEW KELLOGG MAGNETO GENERATOR.

The generator shown in the illustrations and manufactured by the Kellogg Switchboard and Supply Company, Chicago, Ill., possesses a new design of armature which does away entirely with the alleged objections and inefficiency of the old scheme. At "A," in Fig. 1, is shown a cross-section of this new type of armature, the construction of which is a considerable departure from the accepted standard. The core is of the shuttle type and made from dense silicon iron, which

is very soft and permeable. The usual one-piece shaft, as before described, has been supplanted by steel shaft projections attached to either end of the armature core by means of heavy brass discs, as shown in Fig. 2. These shaft projections are made self-centering by turning shoulders in these discs, which accurately fit recesses turned in the ends of the armature core, thereby ensuring easy interchangeability and accurate running of the completed armature. The chief advantages gained in this design are a greater cross-section of the iron in the core proper and a large winding space. In this type it is possible to wind the wire smooth and without piling up at the ends. For this reason this generator armature has a large current output and is capable of a better insulation of the winding, together with greater durability.

The general construction of the various parts of this type of generator is shown in Fig. 3. The self-centering feature of the armature-shaft and end-plates, together with the rigid construction of the pole-pieces, makes it possible to run the generator with a very small air-gap.

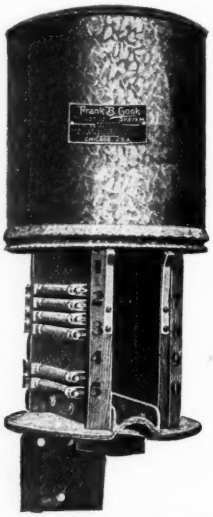
In considering the output of magneto generators, it has been the practice in the past to use different units for measurement. In consequence the results have been misleading and not in accordance with actual results obtained in service. It has been found in practice that the effective electromotive force must be great enough to overcome the line resistance, and the current forced through by this pressure must be of sufficient quantity to ring all of the bells bridged across the line. The effective pressure and current are thus the two necessary factors, the product of which may be designated as watts output. With other factors remaining the same, the maximum watts output depends on, first, larger cross-section of the armature core; second, greater number of turns of the armature winding; third, the smallest possible air-gap or clearance between the poles and armature surface. Each of these changes increases the effective electromotive force of the generator and therefore increases the current output.

A great factor tending to cut down the output of the generator, and one which in many cases is overlooked, is the armature reaction. This reaction depends primarily upon the amount of iron in the armature and the size of the winding, and it is evident that from the construction indicated in Fig. 3, these points have been considered and that the armature reaction has been reduced to a minimum.

Some New Cook Terminals.

Frank B. Cook, 249 West Lake street, Chicago, Ill., has placed on the market several new terminals embracing many points of originality. The latest Cook terminal is specially designed to meet the needs of exchanges which are equipping their plants with an "all-cable" construction. The type T-4 Cook terminal is adapted for multiple tap work. The terminal itself consists of the usual malleable iron bracket, on which are mounted two upright hard-maple strips.

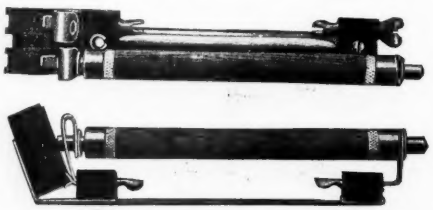
The protectors are arranged on indi-



NEW T-4 COOK TERMINAL FOR MULTIPLE TAP WORK.

vidual mountings, so that one pair can be installed at a time. Any initial capacity can thus be secured, and the capacity of the terminal can be increased as desired by adding the protector mounts.

Two views are shown of the individual protector mounts, from which it will be seen that a simple spring device has been



TWO VIEWS OF THE INDIVIDUAL MOUNTS

used for clamping the fuses in place. This device holds the fuses securely in place, and ensures perfect contact.

All the old-style screws and nuts are done away with, and with this arrangement it is claimed that it is impossible for even a careless man to leave a loose connection. The protection consists of the regular Cook tubular fuse and carbon lightning arrester, separated by a celluloid dielectric.

This celluloid dielectric is also a new idea of Mr. Cook's, which is meeting with great favor, and he states that a number of the largest companies in the country have entirely replaced their mica or silk

NEW T-6 COMBINED TERMINAL AND DISTRIBUTING RING.

dielectrics with these celluloids. Mr. Cook claims that the celluloids do not vary in thickness, and consequently are reliable in their operation.

The type T-6 terminal is another new idea, in which the terminal is combined with a distributing ring. As in the type T-4 Cook terminal, the protectors are arranged on the individual mounts, so that one pair can be put on at a time, and the porcelain knobs can also be added one at a time, a galvanized bolt and nut being furnished for the purpose. Both the type T-4 and T-6 terminal are made for either solder or screw connections. Both types are equipped with a galvanized sheet

NEW T-6 COMBINED TERMINAL AND DISTRIBUTING RING.

metal cover, equipped with special springs which automatically lock the cover in place when it is raised, and hold it up. On account of the ease of access to all connections, no balcony is necessary with a Cook terminal. The type T-4 and T-6 terminals are made in any capacity from ten to fifty pairs.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

AUGUSTA (GA.) TROLLEY LINES SOLD—Unofficial announcement is made of the sale of the Augusta (Ga.) trolley system and lighting plants, properties aggregating nearly $2,000,000 passing into the control of R. L. Williams and E. H. Harriman.

CALIFORNIA GAS AND ELECTRIC CORPORATION—A merger has been effected of the California Gas and Electric Corporation, with a capital of $10,000,000, and the San Francisco Gas and Electric Company, with a capital of $15,840,000. The new concern is to be known as the Pacific Gas and Electric Company. The field of operations includes twenty-five counties in central California.

POWER PLANT AT PARRAL, MEXICO—It is announced that a large power plant is to be erected by the firm of Stallworth Hermanos, of Parral, Mexico. It is expected that the water power of the surrounding region will be utilized, and that the electric current will be utilized for the driving of the concentrating apparatus for the mining work of the vicinity. The capitalization will be about $10,000,000.

LARGE POWER PLANT PLANNED FOR TENNESSEE—It is expected that a bill will be introduced in the session of Congress just opened, granting a large Philadelphia electric concern a franchise to develop the power of the Mussel shoals on the Tennessee river. The engineers of the company have reported that there is enough power at the shoals to supply a large number of cities within quite a distance of the power plant.

NEW YORK CENTRAL ELECTRIC LINES—The Rochester Railway and Light Company has been purchased by the Andrews-Vanderbilt syndicate. The company owns practically all of the lighting plants and traction lines in and around Rochester, N. Y. It is understood that by this means the New York Central Railroad has secured one of the most important links in an extensive system of electric traction which it is proposed to establish between New York and Buffalo.

CITIZENS' TELEPHONE COMPANY, OF ST. JOSEPH, MO., INCREASES CAPITAL—At a meeting of the officers and stockholders of the Citizens' Telephone Company, of St. Joseph, Mo., on November 25, it was unanimously voted to increase the capital stock of the company from $150,000 to $1,000,000. The funds from the sale of this stock will be used in improvements in accordance with the new policy outlined by the telephone company. A new central energy exchange will be established at once.

TO DEVELOP THE BLACK RIVER, WIS.—The La Crosse Hydro-electric Light and Power Company is planning to construct a large water-power plant on the Black river, near Black river falls. The company is capitalized at $1,000,000, and has a state charter granting rights to erect and maintain a water-power plant at Mormon Riffles. It is estimated that a minimum of 12,000 horse-power will be developed, with a possibility of 20,000 horse-power. The current will be transmitted fifty-five miles to La Crosse. The incorporators are Orlando Holway, E. G. Boynton and Roy E. Bigham, all of La Crosse, Wis.

ELECTRIC ROAD TO TAP CALIFORNIA MINING SECTION—The Electrical Power Syndicate, headed by Eugene de Sabla and John Martin, it is announced will spend $2,000,000 in building a railroad to connect Nevada City and Grass City with Auburn and Marysville. The line is to be sixty-seven miles in length. The same company is also planning to build an electric road from Sacramento down through the Sacramento valley. Work on both lines is to begin within ninety days. In connection with the Marysville project, rights of way are being asked for at the present time. The electric road will penetrate and develop an entirely new section of the mountain country.

POWER OF LIGHT COMPANIES—Supreme Court Justice Maurice L. Wright, at Utica, N. Y., recently rendered a decision upholding the constitutionality of the law which gives to electric light and power companies the right to condemn lands which may be required in the attempts to furnish municipalities with light and power. The East Creek Electric Light and Power Company sought to acquire the lands of Norman Loucks, and asked for the appointment of a commission to assess the damages. Loucks resisted and attacked the constitutionality of the statute. Justice Wright holds that the legislature has the power to invest in companies providing municipalities with a supply of electricity for power and lighting the same rights that are held by companies engaged in furnishing cities and towns with water.

LARGE EXTENSION OF TRACTION LINES—One of the largest undertakings in the extension of traction lines is the plan to unite Louisville with Chicago, Indianapolis, St. Louis, Cincinnati, Cleveland and other cities. The Louisville & Northern Railway and Lighting Company, which filed articles of incorporation at Indianapolis last month with a capital stock of $5,000,000, is understood to be behind this proposition. The company will construct a network of electric lines in southern Indiana, joining in its work with the Louisville & Southern Indiana Traction Company. The first connecting link will be built between Jeffersonville and Sellersburg, which will later be extended to Seymour, Ind. From this point the line will make connections to Indianapolis. The incorporators of the new company are J. C. Henderson, R. W. Waite, William Newhouse, Roy F. Bornwasser and C. D. Kelso.

MASSACHUSETTS ELECTRIC COMPANIES DEFER DIVIDEND—The sixth annual report of the Massachusetts Electric Companies, covering operations for the year ending September 30, 1905, shows a surplus of $361,862. The report states that the business for the year was ordinary, and that, due to the labor trouble at Fall River and the unfavorable weather, a better showing was not made. The properties controlled earned $734,310, as against $438,717 in 1904, and $846,855 in 1903. Last year four per cent was paid on the preferred stock, but in 1905 nothing was paid. Concerning dividends, President Abbott says: "The unusual amount of reconstruction determined by the railroad commissioners during the past year necessitated a charge of $311,971 to the profit and loss account. The remaining surplus permitted dividends of only two per cent, except the Hyde Park Electric Light Company, which earned and paid eight per cent. These dividends were paid into the treasury of the Massachusetts Electric Companies, but, after charging off the discount on the coupon notes, your trustees have thought it wiser not to declare any dividend on the preferred shares, in view of the work still to be done on the properties."

NEW PUBLICATIONS.

LIME VERSUS GYPSUM PLASTER—The National Lime Manufacturers' Association has published, in pamphlet form, an article entitled "Lime versus Gypsum Plaster," by R. S. Edwards, B. S. This paper won the first prize of $100 offered by the association for the most accurate and up-to-date article on the subject.

MOODY'S MAGAZINE—The first issue of *Moody's Magazine*, a monthly review for investors, bankers and men of affairs, has been issued, bearing the date of December, 1905. The contents include a critical comment on current events, a symposium on the increasing supply of gold, an article by Thomas Gibson, on "The Pitfalls of Speculation," and articles by Charles A. Conant, Burton L. Read and A. H. Pogson. In addition to this there are editorials, comments on the stock market outlook, correspondence, an enquiry department, and a review of new books on money, banking, insurance, etc. The magazine is published by the Moody Corporation, New York city.

AUTOMOBILE NOTE.

ENERGY CONSUMPTION TEST OF ELECTRIC AUTOMOBILES—On Tuesday evening, December 12, Mr. Alexander Churchward delivered, before the Automobile Club of America, 753 Fifth avenue, New York city, a lecture on "Energy Consumption Test of Electric Automobiles," giving a practical demonstration of the use of the various forms of apparatus.

ELECTRIC RAILWAYS.

MILWAUKEE, WIS.—Fifty new cars of the large type now in use have been put in commission by the Milwaukee Electric Railway and Light Company. They cost $250,000.

WABASH, IND.—It is reported that the Big Four Railroad has purchased the Indiana Central Traction Company line from Wabash to North Manchester, the grading of which is nearly completed.

CHEHALIS, WASH.—The Chehalis city council has granted a thirty-five-year franchise to the Centralia-Chehalis Electric Railway and Power Company to build and operate an electric line in the city of Chehalis.

CHICAGO, ILL.—H. M. Byllesby & Company have purchased control of the Zanesville Railway, Light and Power Company and the Mansfield Railway and Light Company from Rudolph Kleybolte & Company.

BRUNSWICK, GA.—The Southern Electric, Gas and Water Company, which has the franchise for the building of a street-car line in Brunswick, announces that work on the new road will begin immediately and that cars will be in operation by June 15.

TULSA, I. T.—A street-car franchise has been granted by the Tulsa council to L. F. Parker, of St. Louis, George E. Johnson, of Shreveport, La., and five Tulsa men. Construction is to commence in sixty days, and two miles of track are to be completed in fifteen months.

SPRINGFIELD, MO.—The Springfield Traction Company has been sold to the McKinley syndicate and will be extended to Joplin. Colonel T. H. Murray, W. B. Sanford and H. B. McDaniel, local capitalists, recently obtained control of about 375,000 of the 400,000 shares of stock.

NEW ALBANY, IND.—Work has been commenced by the Louisville & Northern Railway and Light Company, which filed articles to build a system of electric lines in southern Indiana, connecting with Louisville over the line of the Louisville & Southern Indiana Traction Company.

STURGEON BAY, WIS.—J. A. Becker, of Milwaukee, is seeking the franchises for an electric line from Sturgeon Bay to many of the towns on Fish creek and Sister bay. Mr. Becker, it is said, can obtain the backing of Chicago financiers, and believes that the line would be a paying enterprise.

ENSLEY, ALA.—It is understood that the Birmingham Railway, Light and Power Company will at an early date begin work on the extension of the Tuxedo car line to Owenton, where it will connect with the Owenton line to Birmingham, making a new direct line between Ensley and Birmingham.

BOSTON, MASS.—The railroad commissioners have authorized the Ware & Brookfield Street Railway Company to increase its capital stock by $100,000 for the purpose of operating and improving the property of the Hampshire & Worcester Street Railway Company, which was purchased at a receiver's sale.

EVANSVILLE, IND.—The first rails of the Evansville & Mount Vernon Traction line have been laid, and this work will be completed by the first of the year. It is expected cars on the new road will be running early in the spring. Cars will be running on the extension of the Evansville & Newburg Traction line into Boonville by March 1.

BLOOMINGTON, IND.—By a unanimous vote the city council granted a franchise to the proposed Indianapolis, Vincennes & Evansville Electric line. Work is to begin by next May, and to be completed by December 30, 1907. The road is understood to be backed by Hugh McGowan, and is an extension of the Indianapolis & Martinsville line.

KENOSHA, WIS.—A. C. Frost, of Chicago, president of the Chicago & Milwaukee Railway Company, is now the sole owner of the franchise of the Kenosha Electric Railway Company. The consideration, it is understood, was $350,000, a cash deal. The purchase included all the stocks and bonds of the road formerly held by Bion J. Arnold, of Chicago.

PROVIDENCE, R. I.—The new trolley line between Providence and Woonsocket paralleling the New York, New Haven & Hartford on the west, has been opened to public travel. The line is fourteen miles long, two miles shorter than the steam railroad between the two cities. The run between Providence and Woonsocket is to be made in about forty-five minutes.

KNOXVILLE, TENN.—A charter has been granted the Knoxville, Sevierville & Newport Railway Company, which has a capital stock of $25,000. The incorporators are S. P. Condon, John B. Brabson, Jerome Templeton and others. The last legislature passed an enabling act permitting the county court of Sevier county to issue bonds in the sum of $50,000 as a subsidy for any company that would build between Knoxville and Sevierville.

SAN JOSE, CAL.—The new owners of the San Jose-Santa Clara and Alum Rock electric railways have petitioned the San Jose city council for a franchise to change the entire system to a broad gauge road. They ask that this franchise be given for fifty years. D. F. Hanchett, the president of the company, states that $1,000,000 will be expended in rebuilding and equipping the road. This work will commence as soon as the franchises are granted.

FAIRMONT, W. VA.—The directors of the Fairmont & Fairview Traction Company, which has been formed to build an electric railway between Fairmont and Fairview, a town in the Marion county oil field, twelve miles distant, have elected the following officers: president, E. L. Rutherford, Scottdale, Pa.; vice-president, S. L. Dillinger, Baltimore, Md.; secretary, Charles E. Conway, Fairmont, W. Va.; treasurer, B. F. Overholt, Scottdale.

YOUNGSTOWN, OHIO—All the surveys for the new Akron-Youngstown trolley line have been made at a cost of $17,000, and it is now stated authoritatively that the actual work of building the new line will be begun in the spring. The line will run from Youngstown to Canfield, then to Atwater, from there to Mogadore and to Akron. Between Atwater and Mogadore a junction will be established and from that point a spur will be run to Canton.

BUFFALO, N. Y.—The Elmira & Waverly Railroad Company, which was incorporated to build an electric road between Elmira and Waverly, has passed into the hands of a receiver. When the company asked the state railroad commission for a permit to build it was found that the papers of the company had not been legally drawn. The company then withdrew the application, and the Elmira, Corning & Waverly Railroad Company was organized to construct the proposed road. Justice Lyon has appointed Joseph A. Powers, of Troy, as receiver. Several actions to recover on claims have been brought against the company, but Justice Lyon has granted an order staying payment, returnable on or before March 6, 1906.

WORCESTER, MASS.—The incorporators of the Worcester & Providence Street Railway Company, which was incorporated by the general assembly last winter, held their first meeting in the Banigan Building, Providence, recently, the principal business being the election of officers and a board of directors. The incorporators adopted a set of by-laws and elected the following men to fill offices designated: president, Fred C. Hinds, Boston; vice-president, Frank W. Tillinghast, Providence; secretary and treasurer, Charles H. Wilson, Boston; directors, Frank W. Tillinghast, Providence; Horace A. Kimball, Providence; Walter R. Bartlett, Burrillville; Fred L. Sayles, Pascoag, and Charles H. Wilson, Elmer L. Weeks and Fred. C. Hinds, all of Boston. This new road, as its name indicates, is to be operated between Providence and Worcester, and is for the transportation of both passengers and freight by electric cars.

NORWICH, CT.—The directors of the Norwich, Mystic & Westerly Street Railway Company have awarded to the National Construction and Equipment Company, of New York, the general contract for the construction of a trolley line from Norwich to Westerly, R. I. Work will begin at once, and the contractors will sublet parts of the contract in order to expedite operations. Work is to commence at both Norwich and Westerly. The building of the road will cost about $500,000. Sixty-five per cent of the length of the road is absolutely straight, and a large part of the line will run over private rights of way, thus permitting the operation of cars at high speed. In addition to the regular local service the company intends to run express cars at a high rate of speed and making close connections with trains for Boston, New York and Providence. The location of the power station has not yet been decided on definitely.

ELECTRIC LIGHTING.

SNOHOMISH, WASH.—The new plant of the Snohomish Electric Light Company has been started up.

SCHUYLERVILLE, N. Y.—The Consolidated Electric Company is extending its line from Greenwich to Trionda.

LYONS, N. Y.—The Lyons board of trustees has granted a franchise to the Niagara, Lockport & Ontario Power Company.

ELLENVILLE, N. Y.—The wires of the Poughkeepsie Electric Light Company are being extended from Highland to Milton.

MILLIS, MASS.—The Edison Electric Illuminating Company has assumed control of the Medfield Electric Light and Power Company's business.

NIAGARA FALLS, N. Y.—Work has been begun on the new $100,000 transformer station for the Niagara, Lockport & Ontario Power Company near Lockport.

GLACE BAY, NOVA SCOTIA—The power-house for the electric light system of the town of Glace Bay, is now about complete, and the new machinery is being installed.

DAVENPORT, IOWA—The prices for electric street lights agreed to by the city council of Davenport are $78 for all-night service, and $64 for a moonlight schedule of 2,450 hours.

FOLSOM, CAL.—The American River Electric Company has a large force of men engaged in constructing a power line from Folsom to the company's substation No. 2, located at Salisbury, about six miles below Folsom.

ROCKVILLE, MD.—Rockville is again lighted by electricity. The rehabilitation of the lighting plant which was disabled by fire several years ago, was completed a short time ago and the town has since been lighted.

DETROIT, MICH.—The annual report of the public lighting commission of Detroit for the year ending June 30, 1905, shows that that city gets its lights for $59.34 per lamp per year. The total investment in the plant has aggregated $1,112,455.40.

ALMEDA, CAL.—The Almeda city clerk has been instructed by the city trustees to advertise for bids for a new 240-kilowatt engine, to be installed at the municipal electric light works; also for a generator of 384 horse-power, duplicating the present machines, at a cost of about $20,000.

HELENA, MONT.—The Helena Light and Railway Company, which was organized in September to take over the properties of the Helena Light and Traction Company, is offering $850,000 five per cent twenty-year sinking fund gold bonds. This is part of an authorized issue of $1,500,000.

APPLETON, WIS.—A lighting plant is to be installed at Lawrence University. The plant will have a capacity of 200 sixteen-candle-power lights, and will be entirely independent of the lighting plant of the Wisconsin Traction, Heat, Light and Power Company, which now furnishes light at Lawrence.

LURAY, VA.—The town council of Shenandoah has closed a contract with George C. Morgan, of Chicago, for the installation of a waterworks and electric lighting system. The power will be obtained from the Shenandoah river, near the town. It is said the entire system will not cost more than $25,000.

FINDLAY, OHIO—Forest and Dunkirk have let contracts for lighting the towns with electricity, the former to pay $2,500 per year for an all-night service from twenty-nine arc lights. Dunkirk will be furnished with twenty-six lights on the moonlight schedule for $80 per light per year. The joint power-house will be built at Forest.

LANSING, MICH.—The ordinance granting to W. L. Haag the use of the streets of Lansing for the purpose of installing poles and wires for furnishing electrical power has been passed by the council. A section was added providing that the city shall have the right to purchase all of the rights and privileges at the expiration of the franchise.

WALLA WALLA, WASH.—Permission has been granted to the Umatilla Electric Power Company for right of way for transmission of power through the Weneha forest reserve, and the way is now clear for the company to establish a power system and carry out its original plans. Over three years ago the company was formed for the purpose of developing a power source on the north fork of the Umatilla, just above Bingham Springs.

BUFFALO, N. Y.—The Referendum League, it is stated, will, at an early date, have introduced a resolution directing the commissioner of public works to obey the recent vote of the people in relation to a municipal electric light and power plant. The league considers the vote sufficiently strong to justify the common council in establishing such a plant.

PORTLAND, ME.—The Portland Lighting and Power Company has practically completed its plans for the construction of a large and up-to-date power-house in Portland in the spring to meet the demands of a business that has outgrown the two plants that are now in use at Woodfords and Great Falls. The company has already engaged an architect and engineer to prepare the plans.

BALTIMORE, MD.—At the annual meeting of the Hamilton Water, Light and Power Company the following officers were elected: president, William McCallister; vice-president, A. G. Struven; secretary, J. Neidhardt; financial secretary, J. C. Toland; treasurer, J. T. Carter; board of directors, William McCallister, A. G. Struven, J. Neidhardt, J. C. Toland, J. T. Carter and A. F. Sefton.

NEW MANUFACTURING AND CONSTRUCTING COMPANIES.

CHICAGO, ILL.—The Darche Electric Clock Company, of Chicago, has been incorporated by Frank W. Jansen, A. Y. Jansen and C. D. Faheney. The capital is $40,000.

ALBANY, N. Y.—The Greenwich Electric Company, of New York city, has been incorporated with a capital of $5,000. The directors are J. T. Ramsay, W. C. Ward, E. Tobieson, New York.

NEW YORK, N. Y.—The Intercolonial Trading Company has been incorporated by Benjamin Blum, C. L. de Muralt, and A. Blum, of New York city. The company is capitalized at $1,000, and will deal in electrical goods.

SANTA FE, N. M.—The Nash Electrical Supply Company has filed incorporation papers, the capital stock being $15,000 and the headquarters Albuquerque. The incorporators and directors are M. Nash, K. T. Nash and Carl Gilman, of Albuquerque.

MUNCIE, IND.—The United States Electric Sign Company, which has been operating in Westside for several months, has been incorporated with a capital stock of $10,000, and the following directors: Charles F. Chandler, Sybil Chandler and R. H. Osgoodby.

NEW YORK, N. Y.—The Oakman Manufacturing Company, New York, has been incorporated to manufacture gas and electrical apparatus, etc., with a capital of $50,000. The incorporators are: J. Fred. Mosby, New York; E. M. Maloney, Brooklyn; A. A. Kelley, Montclair, N. J.

ALBANY, N. Y.—The Franco-American Electric Company, New York, has been formed to manufacture machinery, electrical and mechanical appliances. The capital is $50,000, and the incorporators are: Bernard Braunstein, Hoboken, N. J.; Simon Braunstein, Jacques Ochs, both of New York; Andrew H. Hoag, Brooklyn.

SPRINGFIELD, ILL.—The secretary of state has issued a certificate of incorporation to the Central Electric Manufacturing Company, of Rock Island. The incorporators are William H. Edwards, Gustav Stengel and Henry Tappendorf. The capital stock is $30,000. The company will manufacture dry batteries and electrical appliances of all kinds.

BUFFALO, N. Y.—A certificate of incorporation of the Babcock Electric Carriage Company has been filed with the county clerk. The company is capitalized at $100,000. It will make, sell and otherwise deal in motor vehicles of every sort; its head office being in Buffalo. The directors are: Frank A. Babcock, Frank L. Bapst, Harry Yates, Robert B. Adams, Samuel J. Dark, Charles E. Williams and Thomas D. Powell, all of Buffalo. The capital stock of the concern is to be divided into 1,000 shares of the par value of $100 each. Each of the directors is credited with one share of the stock. The company will start business with a capital of $85,000.

NEW INCORPORATIONS.

BOISE, IDA.—The Idaho Falls Electric and Power Company. $125,000. To build a dam across the Snake river two miles above the Boise city bridge.

GUTHRIE, OKLA.—Anadarko & Apache Telephone Company. $30,000. Incorporators: H. A. Dyer, O. W. Rovers and W. J. Skidmore, of Anadarko.

GUTHRIE, OKLA.—Farmers' Cooperative Telephone Company, of Geronimo. $25,000. Incorporators: J. L. Porter, L. L. Young and Alexander Scruggs.

COLUMBUS, OHIO—Geauga County Telephone Company, Chardon. $10,000. Incorporators: R. C. Crater, W. R. Nutt, A. S. Brown, James Nivin, J. T. Daniels.

RICHMOND, VA.—Courtland Emporia Telephone Company, Drewryville. $5,000. Incorporators: D. B. Drewry, president; F. P. Pope, secretary and treasurer.

TRENTON, N. J.—The Parral Power and Reduction Company, Paterson. To build stations for the generation of electrical or other power. $500,000. Incorporators: John L. Griggs, Wm. Berdan, Harry E. Griggs, Paterson.

SOUTH BEND, IND.—The St. Joseph Valley Telephone Company. To do business in Elkhart, LaPorte, St. Joseph, LaGrange, Steuben, Noble, Kosciusko, Marshall and Starke counties, with main offices at South Bend. $25,000. Directors: Theodore Thorward and Jerry Donovan, of South Bend, and Martin E. Crow, of Elkhart.

GUTHRIE, OKLA.—Wichita Mountain Traction Company, with headquarters at Roosevelt and Hobart. To build an electric line from Roosevelt to Apache, fifty miles, traversing Kiowa, Commanche and Caddo counties. $250,000. Incorporators: W. R. McKnight, E. A. Coulter, C. L. Johnson and Guy M. Parker, of Roosevelt, and John A. McKeene, of Hobart.

ENGINEERING SOCIETIES.

TORONTO BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—At the regular meeting of the Toronto branch of the American Institute of Electrical Engineers, held on December 8, Mr. R. T. MacKeen read a paper entitled "Multiple Operation of Transformers." On Friday, December 22, the branch will hold a meeting at the School of Practical Science, when Mr. E. B. Walker will read a paper entitled "The Booster Control of Storage Batteries."

NEW ENGLAND STREET RAILWAY CLUB—The regular monthly meeting of the New England Street Railway Club was held at the American House, Boston, on Thursday evening, November 23, President E. E. Potter presiding. Dinner was served at seven o'clock, followed by a business meeting, several new members being elected. This was followed by a paper by Mr. W. S. Bartholomew, western manager of the Westinghouse Air Brake Company and Westinghouse Traction Brake Company, Chicago, on "Air Brakes for Electric Cars."

NON-RESIDENT LECTURE AT THE UNIVERSITY OF MINNESOTA—Mr. J. M. S. Waring, Chicago, Ill., gave a lecture before the senior electrical engineers at the University of Minnesota on December 5, upon "Storage Battery Engineering." Mr. Waring outlined the principal uses of the storage battery, discussed the methods of operation, described the booster, and the advantages of the battery as a central-station auxiliary. As a concrete example of storage-battery engineering, Mr. Waring discussed the reasons for the adoption of storage batteries by the elevated railway companies of Chicago, Ill. He followed out, in some detail, the method of determining the location and method of handling the batteries in these equipments.

PERSONAL MENTION.

MR. WILLIAM A. MOYER has been appointed industrial agent of the Delaware & Hudson Company, with headquarters at Albany, N. Y.

MR. F. D. LAWRENCE, president of the F. D. Lawrence Electric Company, visited New York city during the past week, calling on many of his old-time friends in the city.

MR. J. C. ROTHERY, division superintendent of the International Railway Company at Niagara Falls, N. Y., has resigned. It is expected that N. P. Baker, of Calais, Me., will succeed Mr. Rothery as division superintendent.

MR. H. E. WEBB, it is announced, will retire from the presidency of the Maryland Telephone Company, and will probably be succeeded by Mr. David E. Evans, the vice-president.

MR. D. C. HEMINGRAY, secretary and treasurer of the Hemingray Glass Company, Covington, Ky., was a visitor to New York city last week. Mr. Hemingray reports prospects very bright for a most prosperous business season in 1906.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company, Chicago, Ill., was a visitor to New York city during the past week, and spent some time renewing acquaintances and discharging many business duties in the metropolis.

MR. GEORGE J. MURPHY, for three years superintendent of the Westchester (N. Y.) Electric Railway Company, has been promoted to the post of superintendent of transportation for the entire Union Railway system, with headquarters at West Farms, N. Y.

MR. S. E. WOLFF, for some time past manager of the Jackson (Mich.) Gas Company, has assumed the position of general manager of the Saginaw & Bay City Traction and Light Company, upon the resignation of Mr. B. C. Cobb. Mr. Cobb retires as general manager, although still retaining the position of vice-president of the combined companies.

MR. I. A. McCORMICK has been promoted to the position of general superintendent of the electric division of the New York Central & Hudson River Railroad. Mr. McCormick has been manager of the Harlem line. His jurisdiction is now extended from Mott Haven to High Bridge, on the Hudson division, and to Wakefield (Woodlawn) on the Harlem division.

AMONG MANY of the well-known supply men and manufacturers who visited New York city last week, in connection with the meeting of the Electrical Supply Dealers, were Messrs. W. W. Low, president of the Electric Appliance Company, Chicago, Ill.; C. E. Brown, Central Electric Company, Chicago; H. O. Phillips, of the Phillips Insulated Wire Company, Pawtucket, R. I., and A. H. Pease, Hartford, Ct.

MR. J. J. MYER, for several years representative for the Columbia Incandescent Lamp Company in Indiana, and who recently represented the Sawyer-Man Electric Company in the eastern territory, has returned to the Columbia company, and now has charge of the company's business in the state of Texas. Mr. Myer will make his headquarters in Dallas, and will look after the Columbia company's interests in Louisiana as well as Texas.

MR. ARTHUR WILLIAMS, chairman of the committee on public policy of the National Electric Light Association, has begun the active work of this committee by sending out a copy of the first bulletin of the Anti-Municipal Ownership League. Mr. Williams called attention to the desirability of adopting special measures for the widespread publicity of more correct information than is generally obtained on the subject of municipal ownership.

MR. M. B. STALLMAN has been appointed division manager at Norristown (Pa.) for the United Telephone Company to fill the vacancy caused by the resignation of H. G. Dechant. Mr. Stallman has been in the employ of the company for several years as assistant to the division manager. He has recently had charge of the company's business at Phœnixville and Pottstown. Mr. W. Walker, formerly wire chief at Norristown, has been advanced to the assistant manager's position.

MR. THOMAS R. MERCEIN, general manager of the Electrical Trades' Exposition Company, was a visitor to New York city last week. Mr. Mercein attended the opening of the New York Electrical Show at Madison Square Garden. He is making a trip, which will include Cincinnati, Cleveland and Buffalo. He reports that the outlook is very bright for the electrical show at the Coliseum, Chicago, Ill., January 15-27, and that, of the large manufacturers of electrical apparatus, not a single one is missing from the list of exhibitors.

MR. C. REGINALD VAN TRUMP, Wilmington, Del., formerly manager of the Wilmington City Electric Company, made a trip to New York city recently to consult a specialist regarding the possibility of getting back his eyesight, which has been entirely lost from some difficulty with the optic nerve. Mr. Van Trump is a member of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers, and his fine per-

sonal qualities have won for him the sympathy and encouragement of a wide host of acquaintances.

MR. W. J. SHERWOOD, chief clerk of the general superintendent's office of the Brooklyn Rapid Transit Company, has accepted a place as assistant to the general manager of the Mexical Electric Company. Mr. Sherwood began his railroad work in the office of the train despatcher of the New York Central Railroad, about twelve years ago. He became connected with the Brooklyn Rapid Transit Company in 1895, and has been with that company continuously, with the exception of a short period with the Public Service Corporation of New Jersey.

MR. HARRY C. GOLDRICK has accepted a position with the Kellogg Switchboard and Supply Company, Chicago, Ill., as salesman, to handle the central-southern states. Mr. Goldrick was with the Independent Telephone Company, of Indianapolis, Ind., for over seven years, and has a wide acquaintance in the electrical trade, especially among Indiana telephone interests. He has had an extensive experience in construction, installation, maintenance and operating departments, and his experience in the purchasing department of the Indianapolis Telephone Company fits him for his new position with the Kellogg company. Mr. Goldrick is an associate member of the American Institute of Electrical Engineers.

MR. MAX LOEWENTHAL has retired from the Prometheus Electric Company to enter the larger field of electric heating engineering. Mr. Loewenthal will make a specialty of improving the electric heating business of central station companies in large cities, and has made his intitial venture with the Edison Electric Illuminating Company, of Brooklyn. Mr. Loewenthal was born at Oldenburg, a small military town in northern Germany, on February 22, 1874. He received his elementary education in his native city, and when thirteen years of age came to the United States with his father and family. He attended the public schools in New York city, and although he was not familiar with the language of the country, forged rapidly to the front. In the fall of 1887 he entered the Hebrew Technical Institute of New York, and graduated from the electrical course of that institution in 1890. He became laboratory assistant to Mr. George A. Hamilton, chief electrician of the Western Electric Company, and in 1891 accepted a similar position with the Schuyler Electric Company, Middletown, Ct., under Mr. E. R. Knowles. In the early part of 1893 he passed all the entrance examinations at Columbia University, earning a scholarship during the first year which enabled him to go through his course without any further tuition fee. He was graduated from Columbia University with the degree of electrical engineer in 1897. In 1898 he became interested in train lighting, and equipped the first tug in New York harbor with an electrical equipment for lighting the boat, operated from the propeller shaft. He then associated himself with the late Mr. Max Osterberg in consulting electrical work, and in 1901 was one of the organizers of the Prometheus Electric Company, becoming secretary and electrical engineer. He has developed and received patents on a large variety of electric heating and cooking appliances, and was awarded a medal at the St. Louis Exposition for his contribution to the electrical heating industry. He is an associate member of the American Institute of Electrical Engineers, vice-president of the New York Electrical Society, a member of the Pi Lambda Phi fraternity and the New York Press Club, as well as a number of charitable and fraternal organizations.

MR. MAX LOEWENTHAL.

ELECTRICAL SECURITIES.

While the general price movement in the past week's stock market has been decidedly irregular, an upward tendency has prevailed, reflecting a net gain in most of the leading issues. In addition to the opening of Congress, the very high rate for call money which prevailed would seem to act as a check to the bull operations. Notwithstanding this there was so much good support that, as above noted, the price tendency was distinctly upward. Notwithstanding the last government report concerning the cotton harvest, making the total crop below the average trade estimate, the continued reports of industrial prosperity from every quarter kept alive hope that the material difference in prices would offset any shortage. A perusal of the stock list will show that many industries were the subject of active advances, the electrical tractions taking the lead in a number of instances.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 9.

New York:	*Closing.*
Brooklyn Rapid Transit	85½
Consolidated Gas	177
General Electric	184½
Interborough Rapid Transit	211
Kings County Electric	200
Manhattan Elevated	163
Metropolitan Street Railway	118½
New York & New Jersey Telephone	156
Westinghouse Manufacturing Company	190

At the annual meeting of the Metropolitan Street Railway Company the retiring directors were reelected, and the board then reelected the old officers. The officials of the company state that earnings are improving. The completion of the electrification of the Dry Dock line within a month is expected to reduce operating expenses and bring about an increase in earnings. The electrification of the First Avenue line will probably be undertaken next.

At the meeting of the stockholders of the General Electric Company on December 5 it was voted to increase the capital stock of the company by $11,674,500, consisting of 116,745 shares of the par value of $100 each.

Interborough Rapid Transit directors have declared the regular 2 per cent dividend, payable January 2, to the holders of the voting trust certificates of record December 11.

The regular quarterly dividend of 1¾ per cent will be paid on Manhattan Railway stock January 2, 1906.

Boston:	*Closing.*
American Telephone and Telegraph	134⅝
Edison Electric Illuminating	239
Massachusetts Electric	61½
New England Telephone	131
Western Telephone and Telegraph preferred	91

For the meeting of the American Telephone and Telegraph Company on December 21, the books closed December 13 and will reopen December 22.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	80
Electric Storage Battery preferred	80
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	33⅛
United Gas Improvement	96¾

Philadelphia Rapid Transit earnings for November are stated to be in excess of $100,000, as compared with $94,000 for October, $50,000 for August, and $80,000 for July, the first month of the present fiscal year.

Chicago:	*Closing.*
Chicago Telephone	137
Chicago Edison Light	161
Metropolitan Elevated preferred	70
National Carbon common	77
National Carbon preferred	117
Union Traction common	11½
Union Traction preferred	40

The Oak Park Elevated daily passenger average for November was 50,611, an increase of 4,852.

The Chicago Telephone Company's gain in telephones for November was 2,372. The total now in use is 140,187. The directors of the company have declared the regular quarterly dividend of 2½ per cent on the stock, payable December 30. Books close December 26 and reopen January 2.

The regular 1 per cent quarterly dividend on South Side Elevated Railroad stock is payable December 30. Books close December 19 and reopen January 1.

INDUSTRIAL ITEMS.

THE L. B. ALLEN COMPANY, INCORPORATED, 1335 Columbia avenue, Chicago, Ill., is distributing to its patrons a neat blotter and a booklet entitled "If You Use Solder." This emphasizes the advantages of the various Allen soldering compounds.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., is calling attention to the immense number of telephones it has in stock, and its ability to fill large orders for standard telephones immediately.

J. L. SCHUREMAN & COMPANY, 70-86 West Jackson Boulevard, Chicago, Ill., is distributing its new illustrated bulletins, calling attention to the standardization of separate switch arrangement for mechanically operated passenger elevator controllers.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., in catalogue No. 0510 describes the Hunt automatic railway. In addition to the descriptive matter there are illustrations of the apparatus and reproductions of views showing a large variety of typical installations.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., has completed the 1902 edition of electrical appliances with section 16, descriptive of indicators, annunciators, train describers, etc. Sections 18 and 19 are not to be published as part of its 1902 catalogue, but will be embodied in its 1906 edition.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., will be pleased to send its new catalogue giving prices, dimensions, illustrations and code words relative to its plugged steel conduit boxes, "Monitor" conduit bushings, "Erickson" conduit insulators, flexible conduit bushings, and armored conductor bushings.

THE G. W. PRICE PUMP COMPANY, 523 Market street, San Francisco, Cal., has published a catalogue descriptive of the Price centrifugal pumps. These pumps are of various capacities, and are used in all forms of pumping installations. The Price high-duty centrifugal pumps for direct-connection to induction motors are particularly interesting, and full data will be sent upon request.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has hit upon a very happy scheme for keeping in the minds of its patrons its various state agents. The company supplies its state agents with handsome lithographed postal cards bearing a pertinent illumination and sufficient phraseology to keep before the prospective customer the advantages of the Kellogg apparatus.

THE MACON-EVANS VARNISH COMPANY, Pittsburg, Pa., is distributing a folder describing its paraffine insulating paint. This material has recently been put upon the market for use on armature and field coils. The compound is an air-drying and baking material, and possesses the peculiar characteristic of being a good heat conductor, allowing armatures treated with it to dissipate their heat and operate under heavy overloads.

THE STANDARD PORCELAIN COMPANY, New Cumberland, W. Va., has prepared a price list giving dimensions and illustrations of its electric porcelain insulators. The company's works is situated on the Ohio river, ten miles below East Liverpool, Ohio. It has built a large factory, the main building covering more than two acres with a capacity of eleven sixteen-inch kilns. This factory is equipped with the latest and most modern machinery.

THE STERLING ELECTRIC MOTOR COMPANY, Dayton, Ohio, announces that the eastern office will be at 143 Liberty street, New York city. Mr. J. J. Estabrook and Mr. Allen, formerly consulting electrical engineer of the Marine Engine Company, with others, have formed a company called the Engineering Specialty Company, which will have the handling of the Sterling machines in that territory. Mr. Estabrook was formerly New York manager for the Holtzer-Cabot Electric Company. A complete stock of machinery will be kept in New York for immediate delivery in that territory.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., announces that it has decided to discontinue its New York office after December 1. The company has been led to take this step, believing it to be in the interest of its patrons to deal directly with the head office. In fact, the nature of its business, involving as it does such a variety of engineering problems, makes direct dealing desirable, if not essential. The company feels confident that this change will enable it to handle the business more expeditiously than in the past. All communications should be addressed in the future to the Holtzer-Cabot Electric Company, Brookline, Mass.

THE HOLOPHANE GLASS COMPANY, New York city, has prepared a very valuable handbook of engineering data and catalogue of the Holophane system of illumination, comprising Holophane globes and Holophane "Pagoda" reflectors. In addition to the catalogue information, including a code and prices, there is a large amount of technical data detailing the Holophane system of illumination and explaining the method of distinguishing between class A, B and C globes, how to tell pendants from uprights, the absorption losses, a chapter on the Holophane system of illumination, on the care of Holophane globes, on the manufacture of Holophane globes, and on the general subject of illumination. This data book is bound in a handsome flexible morocco cover, so arranged that data sheets may be inserted at pleasure.

THE FROST CROSS-ARM AND LUMBER MANUFACTURING COMPANY, INCORPORATED, Cleveland, Ohio, has purchased some 12,000 acres of land and timber of long-leaf yellow pine near Ocala, Fla., on the Atlantic Coast Line Railroad. The company is erecting a new and modern mill at this point, which will have five times the capacity of its present plant at Chesterfield, S. C. The company will make a specialty of long-leaf, all-heart yellow pine cross-arms. It expects to be in a position to accept orders soon after the first of the year. It will have but one southern office, and this will be located in Florida. Its general offices will probably be moved from Cleveland, Ohio, to some point near Philadelphia, Pa. The name of the company will, in all probability, be changed to the Lake Yale Lumber Company.

THE CENTRAL ELECTRIC COMPANY, 207-211 East Jackson Boulevard, Chicago, Ill., is printing and distributing the 1906 edition of its catalogue. This catalogue contains more than 800 pages, and is the most complete and valuable book the company has ever published. The book is replete with illustrations, and contains much valuable information relating to the latest inventions and devices known to the science. A new feature of this catalogue is the listing of the approximate shipping weights of items, wherever it is possible to estimate this. Where freight rates are involved, and the purchaser makes frequent shipments, this feature will be of particular value. Every article has a code word and a number, and, in addition to the weight of the article, the contents of a standard package are given. The cipher code enables correspondence to be carried on very completely by telegraph. This catalogue is designated as No. 24, and the company advises that all those who have not received a copy should make an immediate request.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY continues to have an enormous demand for its alternating-current motors of the "CCL" type. The favor with which these motors have been received has surpassed the expectations of the company, and it is a matter of gratification to note their successful operation, even under the most severe conditions. A large marble plant has recently been equipped, and although the motors have been operating under overloads and under conditions which require the strongest mechanical construction, their operation has been very satisfactory. Increase in production and decrease in operating costs, as well as absence of the multiplicity of belts, are among the features said to have been secured with this installation. The company has recently equipped a number of grinders for paper mills with alternating-current motors. The question of driving grinders by means of electric motors has been agitated for several years, but there has always been some question as to the feasibility of the scheme. The operation of the grinders installed, however, is stated to have been so entirely satisfactory as to leave no question as to the practicability of this method of driving.